Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLI. NEW YORK, SATURDAY, FEBRUARY 7, 1903. No. 6.

ELECTRICAL WORLD AND ENGINEER

Published weekly by the

McGRAW PUBLISHING CO.

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE - - - - - - 1139 Monadnock Block.
PHILADELPHIA OFFICE - - - - - - 929 Chestnut Street.
EUROPEAN OFFICE Hastings House, Norfolk St., Strand, London, England.

NOTICE TO READERS
WHO ARE NOT SUBSCRIBERS.

The ELECTRICAL WORLD AND ENGINEER is not returnable from the newsdealer. If you desire to purchase the paper from a dealer it will be to your advantage to notify him that you will want it, in order to insure his having a copy for you. If you wish to receive the paper regularly, please send in your subscription so that we can mail it to you direct.

Single copies are 10 cents each. The 52 copies for the entire year cost $3.00 in advance. Please send remittance with your subscription order.

ELECTRICAL WORLD AND ENGINEER.

NOTICE TO ADVERTISERS.

Change in advertisements intended for a particular issue should reach the office of the ELECTRICAL WORLD AND ENGINEER by 10 A. M. MONDAY of the week of issue. New advertisements can be received up to noon of Tuesday of the week of issue.

The first issue of each month is an export issue, having an extraordinarily large foreign circulation in addition to the regular domestic and foreign circulation of this paper.

TERMS OF SUBSCRIPTION.

United States, Canada or Mexico - - - - - - - - - -	per year, $3.00
Foreign Countries, within the Postal Union - - - - - - - -	6.00
Great Britain and Ireland - - - - - - - - - - - -	25 shillings
Germany - - - - - - - - - - - - - -	25 marks
France - - - - - - - - - - - - - -	31 francs
Single copies - - - - - - - - - - - - - -	.10

Remittances for foreign subscriptions may be made through our European office.
In requesting your address changed give OLD as well as new address.

Copyright, 1902, by McGRAW PUBLISHING CO.

Entered as second-class mail matter at the New York Post Office.

NEW YORK, SATURDAY, FEBRUARY 7, 1903.

CONTENTS.

Editorial 221
The Niagara Break-Down 224
Preparations for the Institute Annual Dinner 224
Bournemouth, Eng., Slot Conduit Electric Railway 225
Bull System of Selective Wireless Telegraphy 227
Electrical Resistance of Bearings. By A. E. Kennelly and C. A. Adams. 231
The Industrial Efficiency of Germany 231
Banquet to Marconi in Canada 231
Economic Value of Testing. By Prof. Geo. D. Shepardson 232
New Canadian Niagara Power Enterprise 234
Vicarino Car Lighting System in France 235
Voltage Regulation 236
Work of the Carnegie Institution 237
George Westinghouse in London 238
Wireless Telegraphy Lecture Apparatus 240
Points in the New German Tariff 240
United States Navy Tests of Wireless Telegraphy 241
Sound Condition of General Electric Finances 241
New York Electrical Society at Edison Station 242
A Lecture on Business Automobiles 242
To Develop Trolley Systems in Holland 242
New Telephone Patents 243
Electric Power and Floods 243
Municipal Ownership at Hagerstown, Md. 243
Sale of Richmond, Va., Independent Telephone Company 244
Current News and Notes 244
LETTER TO THE EDITORS:
Water Power vs. Steam Plants. By Jas. L. Thorne 245
Digest of Current Electrical Literature 246
Lundell Fan Motors 251
Moskowitz System of Electrically Lighting Steam Railway Cars from the Axle 250
Walkins Inverted Third-Rail System 252
The New Woodward Water Wheel Governor 252
Double Spiral Filament Lamps 253
Universal Ohmmeter and Faradmeter 253
Improvements in Insulator Brackets and Fastenings 254
The International Telephone Transmitter 255
"Provo" Insulator 255
Combined Fan Guard and Deflector 256
A New Electrolytic Generator 256
Telephone Extension Closer 256
News of the Week 257

FAN MOTOR DEVELOPMENT.

We are glad to learn that fan motor manufacturers consider the prospects excellent for their product this year. There is no cause for surprise in a steady demand for such an article, as it cannot be classed with fads or luxuries. On the contrary, it has made its way into general use by its merits as a purveyor of comfort. Not only does it serve to mitigate the heat of summer, but in a great many instances it answers the purposes of sanitation and ventilation, so economically and efficiently that few other appliances can compare with it. We hardly imagine, however, that the early designers and makers expected to see so large a market for it spring up. The production in 1899-1900 was just about 100,000, and while last year was cool in this country to an abnormal degree, we doubt whether the demand fell off much on that account, although probably some effect was felt. Meantime, a large foreign market has grown up, and the handy little American fan motor can now be seen in a great many parts of the world. The field for its utility, indeed, in southern regions toward and below the equator, we suspect to be capable of indefinite extension, depending, of course, upon the degree to which electrical circuits are introduced or a day load is carried by those already in existence.

Technically considered, the fan motor has rapidly attained perfection in various respects, and has become a remarkably efficient appliance in a very short time. While susceptible of further refinements, keeping pace with the general advance of the electrical arts, it remains pretty much the organism with which we started; in the same manner as the telephone or the incandescent lamp. But even here the ingenious varieties for distributing the breeze engendered, or for projecting warm air—and the like—are evidences of American ingenuity in playing admirable variations upon a well-worn mechanical device. We do not find, however, many indications of important new "models" for 1903. Perhaps that is not a bad sign. When the bicycle fell from its high estate as an athletic craze, one portentous sign was that the manufacturers ceased suddenly producing swarms of new models, and had all they could do to dispose of old stock; and it may be shrewdly suspected that in some instances towards the end the new model was simply a device with which to maintain fictitious prices in face of a dwindling demand. This is not the case with the fan motor. It ranks rather as a necessity than as a luxury, and is a worthy compeer of other electrical appliances that change little, if at all, from year to year, depending upon their qualities as a staple article in the trade. Radical mechanical improvements might come, though we scarcely look for them; and in the meanwhile, it is cheering to note the confidence with which the well established concerns in this branch are preparing to deliver anywhere from 125,000 to 150,000 fans for use this summer at home and abroad.

THE ECONOMIC VALUE OF TESTING.

Prof. Shepardson's strong plea for more extensive testing, in connection with central station lighting, will doubtless meet with general approbation. The necessity for testing and careful inspection increases with the size of the plant operated. In a small house installation, operated say by a gas engine of a few horse-power, and supplying incandescent lamps in the building, the necessities for careful measurement or testing are few. The whole expense of the

system is small, and the economical value of improvements in the mode of operation is also small. But as the size of the plant increases, so does the cost of operation, and so also does the waste due to any error in operation. The economic value of improvement is correspondingly great. Finally, in the very largest central station systems, it pays to employ the best intelligence in all departments of operation. The intelligent control of the engineering department can only be carried on by the possession of accurate knowledge of every significant factor in the system. The possession of such knowledge immediately indicates the direction in which improvements may be secured or economies effected. In order to secure this knowledge, careful measurements and tests must be conducted and continued as a routine. The measuring instrument is the tool of the operating engineer. Without measuring apparatus and the facts deduced therewith, the value of the operating engineer is very greatly reduced. The observations and suggestions of the lineman or dynamo tender, may be as valuable economically as the best he can offer under such conditions.

It is in this way that the application of physics and physical measurements react upon the industrial world. The more highly specialized and the more concentrated the activity of the product, the more precise must be the knowledge, and the more keen the intelligence that must be brought to bear upon the process of production. The more thorough the scientific knowledge in that department, and the more complete the testing facilities of the time in that direction, the more useful can technical intelligence become to the needs of the community. The saving of money in any department of industrial service, consistent with the maintenance of quality, is not only a direct gain to the producer; but also an indirect gain to the whole community.

MOTOR DRIVEN MACHINE TOOLS.

The paper on this topic by Mr. Day, before the New York Electrical Society, which we presented in our columns recently, is one of the most suggestive which we have seen in many a day. Labor saving is the genius of American manufacturing, and the skillful and economical use of tools is the path to industrial supremacy. The American idea is to reach the desired standard of work with the minimum amount of human labor, and as quickly as possible. The first specification cuts down the labor cost, the second tends to keep down the fixed charges. Foreign manufacturers often turn up the nose of scorn at American machine-made products, but they quail before the competition. Now the fact is that while the last refinements of manufacture require skilled hand labor and infinite patience, these very refinements are for ordinary products and purposes both needless and wasteful. It is not necessary or desirable that the frame of a steel building should be fitted to the thousandth of an inch, or that every watch should be capable of a rate of half a second per day. Even in scientific investigation, the mind quickly grasps the points in method and apparatus which require extreme refinement, and those in which lesser pains will not injuriously affect the result. Mr. Day's paper was directed at the economical results to be attained by applying the same principles to machine shop practice. He took up, in the first place, the effect of modern air hardening tool steel on the rapidity and economy of machining. Using this material it becomes desirable greatly to increase the old standard speeds of cutting, and each material and process has its own most economical speed, just as in spinning machinery each frame must have its spindles drawn up to a certain speed to get stable running without endangering the thread.

From this standpoint, the great saving to be effected by motor drives is in the labor rather than in the fuel. All the old cone pulley devices for speed regulation are cumbersome and wanting in delicacy, so that the workman will generally run at an improper speed rather than go to the trouble of changing to one only a little nearer right, for a short period of operation. With an electrically driven tool the speed control can be made so convenient and sensitive that the workman will instinctively regulate his cutting speed to the needs of the work, and so turn out his job more quickly and with better economy in the use of tools. As to method of regulation, Mr. Day inclines strongly to multiple-voltage systems using direct current as being on the whole the most useful and convenient. He is by no means an extremist in advising motors for separate machines, looking at results rather than the principles of construction. It should be noted that electric driving from this standpoint is a very different affair from electric driving in textile mills and similar cases. Here the fundamental idea is to obtain facile control of the speeds of certain machines irrespective of the general character of the drive. There, no special provisions for very precise speed control are used, the drive being for the fundamental purpose of working the machines at a very nearly uniform high speed with the smallest possible waste of power. The one use is a labor saving scheme, the other a refinement of power saving, each being adapted to meet the peculiar requirements of a special branch of manufacture. Motor driving in factories and workshops is not, therefore, a single problem, but a group of problems, each requiring its own solution. An engineer in dealing with these cannot follow freely his preconceived notions, but must get down to the details of the particular manufacture undertaken, and must grasp the distribution of the manufacturing expense before he can properly design the electric drive required. We are glad to note that the paper has been printed by the Society for general distribution.

FATAL SHOCK IN PUBLIC BATHS.

A sad accident is reported from Fulham, London, in recent technical journals. It appears that the Public Baths in Fulham are lighted electrically. The baths are of glazed earthenware of cubical form, with wooden rims. A waste-pipe of gun metal drains each bath. Consequently a man standing in the bath would make a good ground connection at his feet, either by treading directly on the waste-pipe opening, or, through the water in the bath, to the outlet. The bath chambers are separated by enamelled slate partitions, 6½ feet high, rising from a concrete floor. The upper edges of these partitions are supported and united in flanged capping of galvanized iron. The electric lamps lighting the place were supported on metal saddles straddling the partitions. The wires connected to the lamps ran through iron tubes resting in certain places, on the iron capping. The iron tubing holding the wires may have been continuous as far as the switchboard in the bath house. It had not been connected to ground. Owing either to water or to a direct contact with one of the lighting wires, the iron tube became "live." Resting upon the continuous cappings of the bath partitions, these also became "live," and were supported on slate like a regular third-rail system, 6½ feet in the air. The electric supply was at 200 volts pressure of alternating current. It is not stated whether this was derived from a local transformer, or from a secondary system of street mains. It is clear, however, that while one side of the system was connected in some way with the "third-rail" running around the tops of the partitions, the other side of the system was somehow connected to ground. All that a bather had to do, therefore, to get a 200-volt shock, was to stand in the bath and lay his hand up on the iron partition capping. With wet hands, and his feet in water, he would be in a condition to receive a relatively strong current. If it had been a direct current the shock would probably have been

severe, but momentary, because the man's arm would be muscularly thrown off the rail, or the man would collapse into the bath. The danger of fatality would be reduced to that of a momentary nervous shock. With an alternating current, however, a muscular paralysis is produced in which the victim is apt to be violently held grasping the conductor, and the current is kept on, with many shocks per second, until someone can disconnect the conductor.

It happened so in this case. The bath attendant heard a scream from a certain chamber, and, opening the door thereof, found the occupant standing in the bath and clutching the top of the partition with both hands, unable to let go. The scream caused other bathers to lay hold of their partitions in order to try and look over. Several reported having received shocks; and one was found dead in his compartment an hour later. As soon as the current was cut off the attendant found the original victim unconscious in the bath, and efforts to resuscitate him were unavailing. Two men, thus, died from an alternating-current shock at a pressure that was testified to, at the inquest, as having been 200 volts or less.

It seems to have been the unanimous opinion of those who were competent to judge, and examined into the matter, that had the iron tubes holding the wires been permanently grounded the accident would not, and could not, have occurred. Of course the dangerous conditions were here very special; and the ordinary dwelling house or office, wired at 200 volts pressure for alternating currents, presents no such likelihood of danger. But the fact that a pressure of 200 volts is declared to have brought about the death of two men, of ages 38 and 23 years respectively, shows the possible dangers of the alternating current; since it is in the highest degree improbable that the men would have been killed by 200 volts of direct current. It also shows that although such a danger in the ordinary house is quite negligible with 200 volts alternating, the danger in such a house becomes appreciable if there is a chance for an accidental cross between the primary and secondary circuits in or near a transformer; and it emphasizes the importance of permanently grounding secondary distributing circuits.

THE ELECTRIC FURNACE AS A MEANS OF RESEARCH.

Engineers are very familiar with the commercial applications of the electric furnace, and have come to appreciate it as a most powerful means of producing various reactions otherwise unattainable; but in spite of all that has been done it has hardly yet taken its place as an instrument of pure research. Even the brilliant work of Moissan and others in the artificial production of gems squints at commerce rather than mineralogy, and the fact is that this most powerful engine of investigation is much less used in this function than it deserves. The reasons for such a state of things are somewhat complicated. In the first place for the past quarter century inorganic chemistry has fallen into disrepute, and the attention of nearly every first-class chemist has been turned to the wonderfully futile field of organic compounds. These are vastly more manageable in the laboratory, are more amenable to comprehensible theory, and have yielded commercial results of truly immense importance. In inorganic chemistry, on the other hand, the list of fundamental working reactions is a short one and the products tend either to great stability which is inconvenient or too extraordinary instability which is equally bad. Nor has there been evolved any general theory of inorganic compounds that can serve as a guide to research. Inorganic chemistry has, therefore, remained comparatively undeveloped and has largely fallen into the hands of technologists able in their respective lines, but not with time or taste for purely scientific study.

There is, too, a very natural tendency on the part of experienced chemists to shun the so-called "dry" reactions, i. e., those produced without solution of the substances, as uncertain in their results and as giving more copious by-products than the corresponding "wet" reactions. Nevertheless, it is a well-known fact that the products of "wet" and "dry" reactions, nominally the same in effect, are often widely different in fact. To mention a single instance, the phosphorescent sulphides of calcium can be easily made by the latter process while the former fails to produce them. We commonly dodge the issue by ascribing the difference to the realm of physical chemistry, but this is only a convenient way of concealing ignorance. The present interest in radio-active substances has stimulated investigation in inorganic lines, but not yet to edification. Now the electric furnace with its tremendous temperature is capable of enormously increasing the possible range of inorganic reactions, and for this purpose it should form a part of the apparatus of the expert theoretical chemist instead of being as at present mostly in the hands of the technical chemist. We would not in the least depreciate the work of the latter, but it is directed at results rather than at the exact causes of results. Now chemistry, especially physical chemistry, is at a point where extensions of theory are greatly needed. The data are fast accumulating for some tremendous generalizations, and every powerful means of research at hand ought to be worked to the very utmost to furnish additional facts.

Perhaps the very greatest problem of the present in theoretical chemistry is the splitting up of the so-called elements. The indivisible atom has long been discredited, and the recent work on electrons has dispelled the last remnants of its old-time sanctity. Prout and Mendeleef long ago began the attack, but very little has yet been done in actually breaking down the defenses. By splitting up the elements we do not mean the mere isolation of minute traces of hitherto unknown components as in the cases of argon, krypton and their allies, which are akin to the finding of theophene in benzene by Meyer years ago; but the actual breaking down of an element as now known into its definite components. Not a few of the elements have been long open to suspicion. Zinc, cadmium and magnesium, for instance, form a trio conspicuously open to attack. In fact, one noted scientist thought a score of years since that he had broken up cadmium and communicated the result to the French Academy. Iron is another element which is very likely dissociated at very high temperatures, as it probably is in the sun, and who knows what strange properties its components might have if they could be isolated? Perhaps calcium is in the most exposed position of all to successful attack, for it is well-nigh certain that when vaporized at the temperature of the electric furnace it splits off a gaseous component, or passes into a new condition, comparatively simple, nearly as tenuous as hydrogen and well known in the solar atmosphere. If the elements could be split up into their primal components, there is at least a chance that these could be recombined in what marvelous ways no man would now dare to predict. Problems such as these lie at the very foundation of science, and are deserving of the best efforts of the best investigators. It is to this colossal theoretical work that we hope to see engines like the electric furnace successfully applied. And it should be remembered that no great advance in theory has ever failed of producing great advances in practice, sooner or later. The result of an investigation may seem at first remote and lacking in human interest, but it is likely at any time to loom into practical and commercial importance. To look at the matter from the most mean and venal standpoint, it pays to work to its limit every new means of investigation, for no man can foresee when even scholastic and visionary theories may suddenly be coined into hard dollars.

The Niagara Break-down.

At 10:45 o'clock on the night of Thursday, January 29, lightning struck the bridge connecting power house No. 1 of the Niagara Falls Power Company, at Niagara Falls, N. Y., with the transformer station, causing short circuits on the cables carried through the bridge and starting a fire, which, before it was extinguished, caused the greatest ruin ever known in connection with the Niagara power development, and developed conditions that were widespread in their effect. It was, indeed, a truly remarkable occurrence, and while its effects were very extended, it is gratifying to record that it also aided in showing the truly wonderful recuperative powers at command of the Niagara Falls Power Company.

The bridge where the fire started extends over the inlet canal. It is a handsome stone structure with three piers and four arches, and has a slate roof. Running through it from the generating station to the transformer station at the time of the fire were all the cables carrying current intended for Buffalo and various tenants on the company's lands. Approximately there was 50,000 hp passing over 52 cables of 1,000,000 cm capacity. These cables were installed in tiers on each side of the bridge interior and supported on arms or brackets. In each layer, so to speak, there were several cables side by side. The great power station was in operation with the usual load when the lightning shaft fell. The fire was discovered immediately, and the company employees started to fight it. All the generators in the big power house were stopped. An alarm was at once sent in for the city fire department, and this met with quick response. Considering the construction of the bridge interior, it was surprising that the fire should get such a hold, but the insulation on the many cables served as fuel. The flames extended into the transformer station, and there and on the bridge the firemen fought them. A large amount of water was thrown into the transformer station and on the bridge before the fire was conquered. Finally, when it was out, it was found that all of the cables on the bridge had been totally destroyed. The transformer room was badly damaged inside and on the roof, and the interior and roof of the bridge was burned.

The destruction of the 52 cables cut off every customer of the Niagara Falls Power Company, who had been receiving current that passed over the bridge. This included Buffalo and its trolley and lighting plants, numerous industrial establishments, grain elevators, large stores, and, in fact, every one of the patrons of the Cataract Power & Conduit Company, which company is the distributing agent for Niagara power in Buffalo. It also included the Tonawandas and the factories there operated by Niagara power. Also the Lockport plants using the energy of the Falls. The International Railway and all its lines in Buffalo and the suburban places. The majority of the electro-chemical plants in Niagara Falls, on the lands of the Power Company, had their current cut off. While the fire prevailed the big installations of the two power houses were completely shut down. The Niagara Falls trolley cars were without power, as was also the Buffalo & Niagara Falls Electric Light & Power Company, which company operates the lighting system at the Falls. In the suburb of Echota all lights went out, they being a part of the Niagara Falls Power Company's installation. Trolley cars midway between the cities mentioned came to a standstill.

Within an hour after the fire was out current was again supplied for the operation of the trolleys and arc lights of Niagara Falls, this service being fed through the rotaries in power house No. 1, which were all right. But everything that depended upon the cables that had passed through the bridge had to await repairs. Superintendent P. P. Barton and his assistants were equal to the emergency. Before the fire had finished its work of destruction, arrangements were being made to repair the damage. In spite of the fact that it was midnight, every available man was summoned to the task of reconstruction. The Niagara Falls Power Company had a quantity of cable on hand, and other cable designed for the construction work in power house No. 2 was available, as was also a quantity of cable the General Electric Company had on the ground. Temporary repairs were made to the roof of the bridge and to the transformer station. The debris of the fire was cleared. Temporary cables were run and connections made. While the water thrown into the transformer station had wet some of the machines there, all were not rendered useless, and it was possible to connect some of them up. This made it possible to give Buffalo a service as soon as connections were made. Every effort was bent to get current over the transmission line by Friday noon. However, as the current was about to be turned on a short circuit occurred and this retarded matters until 4:30 P. M., at which hour the Buffalo transmission was resumed with 10,000 hp. This was sufficient for the lighting system and for the full operation of the cars of the International Railway Company. On Saturday Buffalo was receiving its usual amount of Niagara power. Other customers were taken on as rapidly as possible, and by nightfall Saturday the majority of patrons of the Niagara Falls Power Company were receiving power.

There are comparatively few places that have 50,000 available horse-power, and to shut off this amount of energy from an industrial section like that about Niagara Falls was to cause idleness in many plants. The incident proved the value of the International Railway Company's storage battery, for this helped out on the lessened service of Thursday night. On Friday the steam plant was put in operation, but even with these sources of power supply it was necessary for the company to greatly reduce the number of cars operated on its lines. It was impossible to keep up the regular trolley service between Buffalo, Niagara Falls and Lockport, but when the transmission was resumed the people more than ever realized the value of Niagara power.

The concern that received their power supply from power house No. 2 were able to run Friday. All these are on the lands of the Power Company.

In reviewing the extent of the damage caused by the fire and the rapid manner in which connections were made and power again sent to Buffalo, it is evident that Buffalo has great cause to be thankful. To a majority of the electrical installations of the world, the destruction of 52 cables like those used at Niagara would simply mean a shut down for many days, possibly weeks. On the contrary, Buffalo received power in less than 24 hours after the Niagara loss. This was only made possible because the Niagara Falls Power Company, realizing the importance of its service and the necessity of prompt work in case of accident, always keeps a full reserve supply of all parts of its machinery and cables liable to injury by accident. Without the cable of the construction work of power station No. 2 and of the General Electric Company, all of which cable belonged to the Niagara Falls Power Company, this company had more than enough cable on hand to repair the damage. It was this splendid supply of reserve cable, and the quick, prompt work of the company's employees that made possible a wonderful feat that is a credit to the electrical profession.

Preparations for the Institute Annual Dinner.

Arrangements for the annual dinner of the American Institute of Electrical Engineers at Sherry's on Monday, February 9, are being pushed rapidly, and there is every prospect of a great success. The speakers will include Mr. Andrew Carnegie, on "Libraries"; Dr. S. S. Wheeler, on "The Latimer Clark Collection"; Dr. J. S. Billings, director of the New York Library, on "The Technical Library"; Mr. R. R. Bowker, editor of the *Publishers' Weekly*, on "The Unity of Science"; Theodore L. De Vinne, the bibliophile and great American printer, on "The Debt of Mechanics to Science," and Dr. J. C. Bayles, technical editor of the *New York Times*, on "Electricity and the Daily Press." President Scott will also deliver an address of welcome. Mr. and Mrs. T. A. Edison have expressed great interest in the affair and signified their intention to be present, and Mrs. Carnegie will also accompany her husband. The city will be represented by the Hon. R. G. Monroe, Commissioner of Gas and Electricity. Several of the past presidents of the Institute will also be in attendance and very cordial letters have been received from them, including Prof. Elihu Thomson and Dr. Louis Duncan, who are both coming over specially from Boston. In order to provide properly for subscribers to the dinner and their friends, the dinner committee requests most earnestly that orders for tickets ($5 each) be sent in immediately to R. W. Pope, 95 Liberty Street, accompanied by a notification as to the persons with whom it is desired to sit. The room will be arranged in tables of eight throughout. The menu cover prepared is a fac-simile in three colors of one of the larger volumes dated 1494, presented by Dr. Wheeler, in the Latimer Clark collection, and shows the volume as it now stands in the Institute Library, label and all. Two of the annotated pages are also reproduced.

Bournemouth, England, Slot Conduit Electric Railway.

THE first electric railway in Great Britain employing the slot conduit was recently opened at Bournemouth, England, the plant having been installed by J. G. White & Co. Only part of the Bournemouth system is thus equipped, the ordinary overhead trolley collector being used on portions of the road, provision being made whereby the shoe can be lifted out of the conduit when the car passes to a trolley section.

As will be seen in Fig. 2 a side and not a center slot is used. The slot, which is 1 in. wide, and serves as one of the running rails, is formed of two rails, held in place by cast-iron yokes at 3 ft. 9 in. centers and embedded in concrete, forming a continuous conduit. As is seen in the figure, the flanges of the rails fit on to the tops of the yokes, and are held up by adjustable tie-bolts. Halfway between every four yokes, and therefore at 15 ft. centers, are the insulators, seen clearly in one of the sections and in the photographic view, Fig. 4. Above is the cast-iron flange, which is bolted to the flange of the slot rail and the drip cap. Within the latter, set in Portland cement, is the insulator itself, which is single-lipped, and set within the insulator, also in Portland cement, is the iron bolt or pin. The surface of the insulator, which is within the cap, as also the surface of the bolt within the insulator, is corrugated so that the cement obtains a good firm grip. Attached to the bolt are the two iron pieces in which the one side of the contact T-rail is inserted, and the distance of the latter from the center of the bolt can be nicely adjusted by an eccentric washer which turns freely on the bolt and acts as a cam, and which can be gripped with a spanner. The T-rails are simply fastened by a pin, and the lengths are bonded. The track is paved with wood, and what may prove to be a disadvantage is that the insulators are not accessible without removing the paving blocks. At points and crossings, one or both conductors are interrupted for 12 ft. to 15 ft. The plough and its carrier are shown in Figs. 3, 4 and 5. Fig. 5 is the plough itself, which consists of a steel neck holding a double board of walnut to which the spring contacts are fastened on either side by clips. They are connected by flexible cables to the top of the carrier and thence to a switch—which is controlled from a small handle at the side of the car—for switching either the trolley or the plough on to the controller. The plough slides in two sets of guides, one set vertical for raising and lowering it, and the other set horizontal, thus enabling the plough, when lowered, to move freely in a horizontal direction at right angles to the length of the car. The traveling head on which the plough is suspended can only move up and down, but, as soon as this head is in its lowest position, the plough rests on the horizontal guides, and releases itself from the head, thus becoming free to move from the side to the center of the car. At each point on the line at which the slot construction stops and the overhead construction begins, the slot changes from side to center slot, and the slot ends at a plough pit (Fig. 6). The two covers of the pit normally leave a space 1 in. wide between them, but they are attached by a single series of links to a lever outside the track in such a way that when the lever is pulled over the covers are slightly raised and pulled back so as to widen the slot considerably, as seen in Fig. 6. Two guides within this pit and sloping down towards the contact rails, help to guide the plough down as it is lowered. The raising and lowering of the plough is effected by a chain roller mechanism seen in Figs. 3 and 6 and the plough when in its upper position is held by a catch. The whole arrangement embodies many parts, but it is practically designed and works very smoothly. To wind the plough up and down, the crank of the controller is removed from the latter and used on the spindle of the chain gear above referred to.

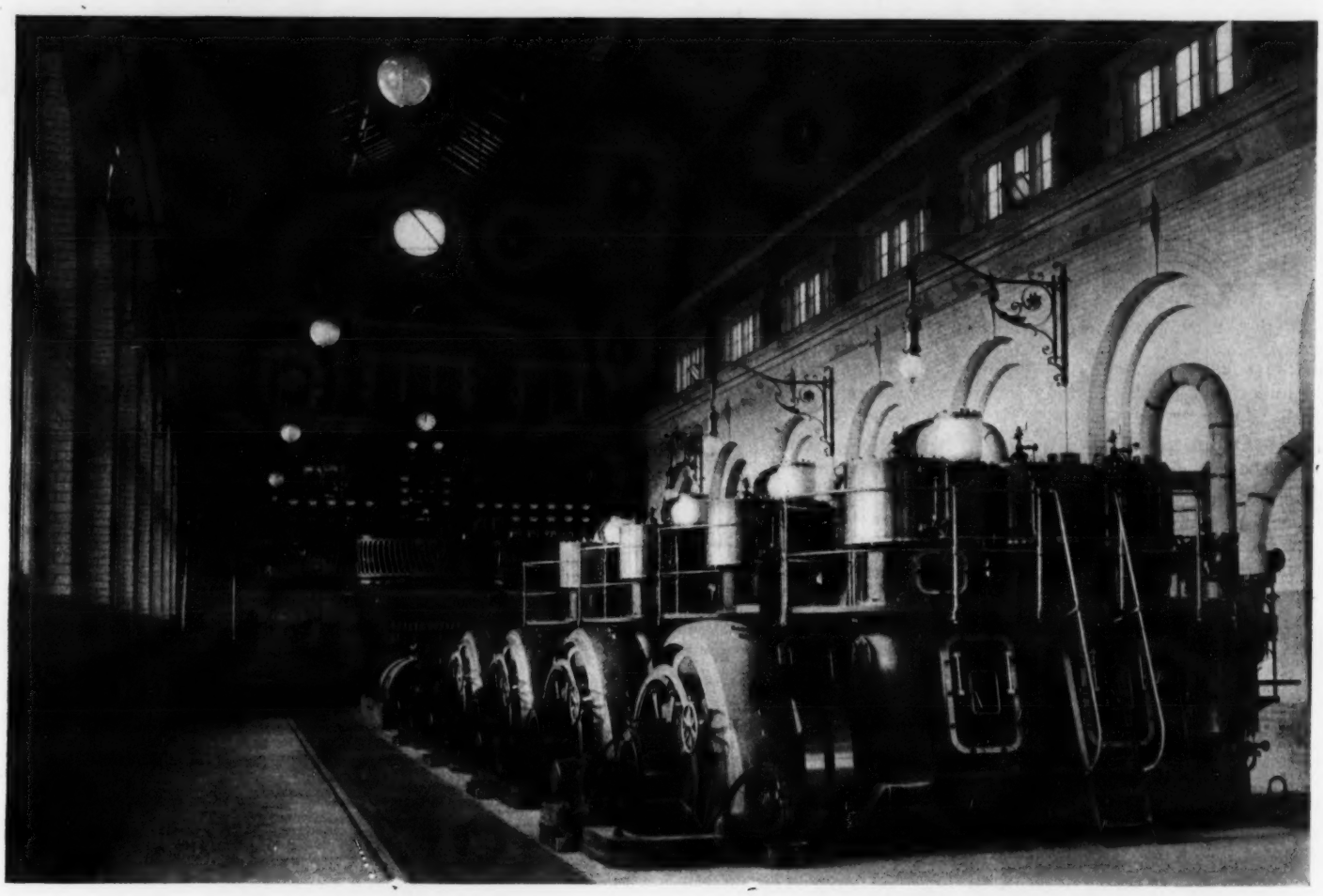


FIG. 1.—GENERAL VIEW OF INTERIOR OF BOURNEMOUTH GENERATING STATION.

The conduit track is divided up into ½-mile sections, and there are two feeder pillars at the end of each section. One of these contains throw-over switches arranged so that the polarity of the contact rails on either side can be reversed; in the other are fuses connecting the feeders to the reversing switch pillar.

There are at present an equivalent in single track of 3 miles conduit line and 15 miles of trolley line. Most of the line is double track, single track being employed chiefly in those cases in which it is necessary to return by side streets on account of the narrowness of the roads, although the gauge is only 3 ft. 6 in. The work was commenced in March last year and completed just before Christmas. The greater part of the lines were then put in operation,

although the government inspection has just been made. The overhead construction is chiefly with single-bracket poles, but in some parts either double-bracket poles or span wires are employed. In several roads the arc lamps for street lighting are placed on the center poles.

The cars are partly single-truck and partly double-truck; in the former case the plough carrier is held in between the framework of the truck and in the latter case it is held by two plates fixed to the axle boxes of the pony wheels of one of the bogies. The single-truck cars have Peckham underframes, and the double-truck cars Brill underframes. The motors and controller equipment are by the British Westinghouse Company, and the ploughs by Messrs. J. G. White & Co., the latter firm having been responsible for the whole of the conduit, track and overhead work. At present only hand and electric brakes are provided, but either air brakes or track brakes will be added, as there are one or two very sharp gradients, one of these being nearly 1 in 9 and with a sharp curve at the bottom. The electrical car equipment comprises two Westinghouse tramway motors, two controllers, one at each end of the car, with combined automatic cut-out and main switch, and diverters, etc., for electric "service" braking. "Nose" suspension is used for the motors. One of the principal features of the controller is that in it the number of contact pieces has been much reduced, without any reduction in the number of speed stops. The control is of the usual series-parallel type, there being three steps for the series, and two steps for the parallel arrangement of the motors; in the braking position there are four resistance steps. The "diverters" through which the current from the motors acting as generators is passed, are iron-framed, fire-proof resistance coils, with large external surfaces.

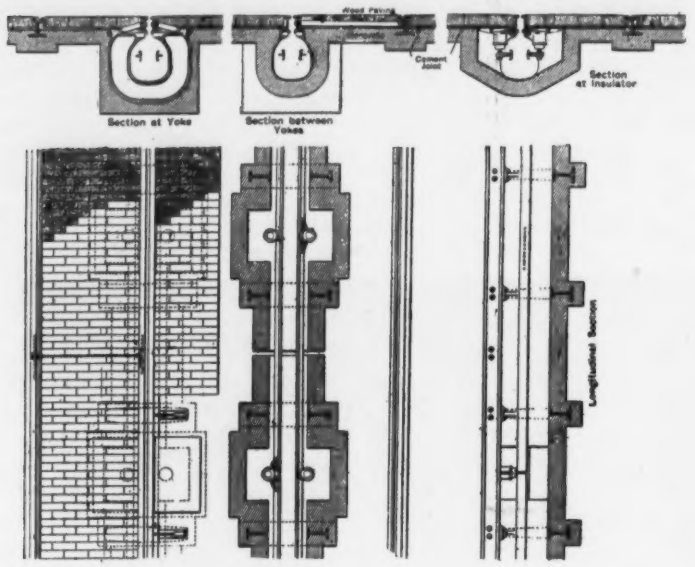


FIG. 2.—SECTIONS AND PLANS OF CONDUITS.

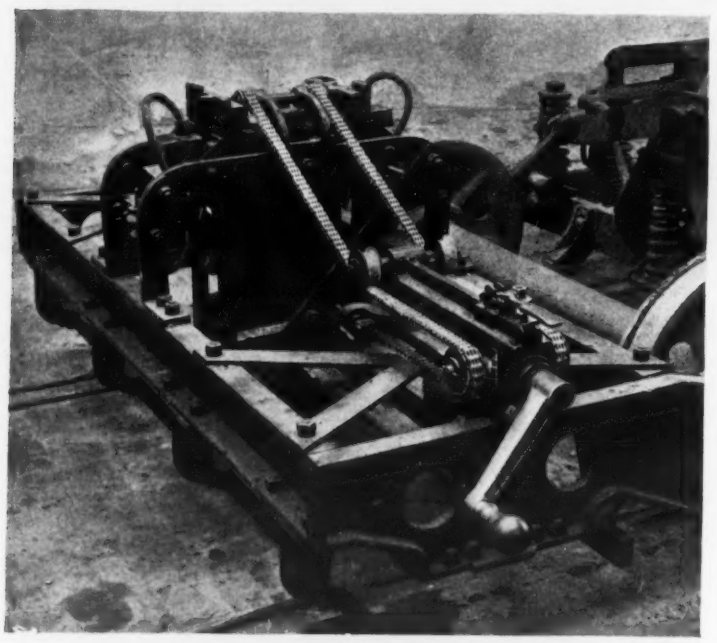


FIG. 3.—APPARATUS FOR RAISING SHOE.

The generating station of the Bournemouth Corporation supplies both the tramways and public lighting, the private lighting in Bournemouth being provided for by a company. In the station are four 292-kw sets running at 360 r.p.m., Fig. 1. The Belliss engines are three-crank, triple-expansion, with cylinders 12 in., 18½ in. and 28 in. diameter by 12-in. stroke, and there is on each a 66-in. flywheel weighing 9,000 pounds. They govern on the throttle, and there is a by-pass, in connection with the governor, which lets live steam into the intermediate cylinder when the throttle is full open and the speed still below the normal, to deal with overloads. The dynamos are eight-polar, of the usual traction type. Their fields are compound-wound for a constant pressure of 550 volts, when giving any current between 50 and 662 amperes, the series winding being ar-

FIG. 4.—CONDUCTING RAIL AND INSULATOR.

FIG. 5.—CONTACT SHOE.

ranged on the negative side of the machine—that is to say, between the negative brush and the negative terminals. The field rheostat for each generator is connected to a 30-way multiple-contact switch on the switchboard, and is capable of reducing the voltage from 550 to 500 volts. These machines are specified to take 25 per cent. overload if necessary, and between no load and this overload the brushes are to run practically sparkless without being shifted. The specified temperature, after a six hours' run at an output of 530 amperes and 550 volts, is not to exceed 60° F. at any part of the machine. Two Belliss surface condensers are provided, each capable of condensing 15,000 pounds of steam per hour, and giving a vacuum of 29 inches.

In addition to the generators already mentioned, the engine room contains a motor-generator in order that the conduit portion of the track, which is run off different bus-bars to the overhead portion, both poles of the conduit line being insulated, may yet be run from the same dynamo. This machine has a capacity of 77 kw.; its motor is shunt-wound and its generator compound-wound, and the speed is 550 r.p.m. The normal output of the generator is 140 amperes at 550 volts, but the machine is capable of giving an output of 140 amperes at 600 volts when running at about 600 r.p.m., and as an emergency load an output of 170 amperes at 550 volts for 10 minutes at a time. The motor works at an e.m.f. of 550 volts, the rise in speed to enable the generator to give its higher output being obtained by inserting resistance in the motor field. Both motor and generator are of the four-pole type, the field rings being deeply set in a common bedplate in order to bring the center of rotation as low as possible. Each armature is mounted on a separate shaft, provided with a half coupling for bolting to the central shaft carrying a cast-iron flywheel weighing about 1½ tons, the arrangement permitting either armature to be removed without disturbing the flywheel.

The switchboard has to supply three sets of feeders which are more or less independent, viz., those for the conduit line, the trolley line and the public lighting. The conduit line is run, as already stated, with both poles insulated, and the trolley line utilizes a rail return as usual, while the public lighting is by 132 arc lamps, in circuits of 11 off the traction dynamos. Each dynamo panel has a throw-over switch which can connect it either to the trolley bus-bars at the top or the conduit bus-bars at the bottom. There is also a reversing switch by means of which the polarity of the conduit rails may be reversed. A water resistance is provided for testing purposes and burning out faults, and it can be adjusted from a handle on the switchboard.

The feeders are lead-covered and paper-insulated, laid in conduits embedded in cement, the ducts being in 2-ft. 6-in. lengths, with 3-in. ways. The traction feeders are single cables, and the public lighting feeders concentric. From the feeding points the cables to the arc posts are single lead-covered, rubber-covered cable being used from the base of the pole to lamp. At the works all the lead-covered cables terminate below the floor level, where they are connected to rubber-covered cables rising to the switchboard.

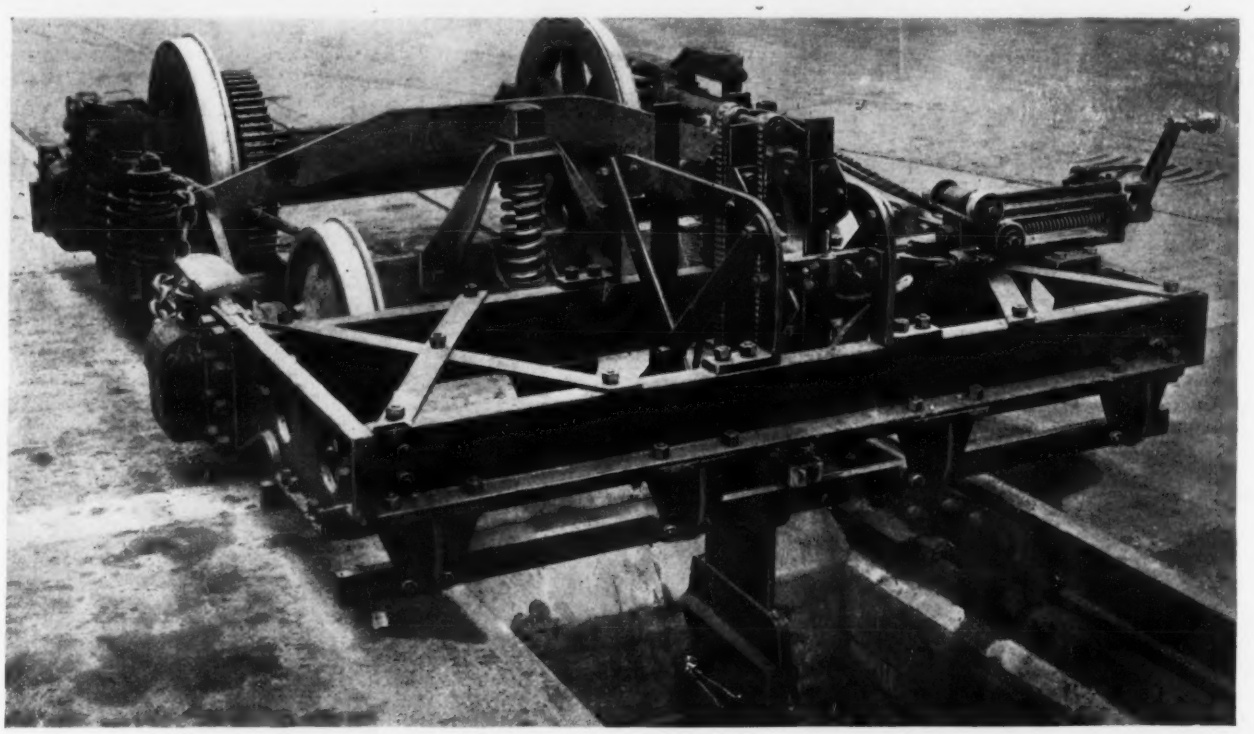


FIG. 6.—VIEW OF TRUCK SHOWING SHOE-RAISING MECHANISM.

Bull System of Selective Wireless Telegraphy.

IN an article contributed to the *London Electrician*, Mr. Andres Bull describes a system of wireless telegraphy of his invention in which, instead of using simple wave impulses in transmitting signals as by other systems of wireless telegraphy, a series consisting of a fixed number of wave impulses, succeeding each other at prearranged short intervals of time is used, and thus it is possible to give the signals from each separate transmitter a distinctive feature of their own. For instance, suppose each series to consist of five impulses, the intervals of time between them being *a*, *b*, *c* and *d*, then by giving these intervals different values it is easy to produce a great variety of series.

If a dot in the Morse code is to be transferred from a station, *A*, to another station, *B*, a series of, say, five wave impulses at intervals *a'*, *b'*, *c'* and *d'* is dispatched. The receiver at *B*, tuned for these intervals, collects the five impulses and registers them as a dot on the tape of a Morse apparatus; in transmitting a dash, a sequence of series is dispatched from *A*, and the receiver at *B* will register a row of dots (a dash) on the tape. If *A* wants to communicate with another station, *C*, a second series is used, the intervals being *a''*, *b''*, *c''* and *d''*. This series will not be recognized by the receiver at *B*, as the intervals do not correspond with the adjustment of the latter. The receiver at *C* will, however, receive and record the signal. In this way, by using series of different forms, one can telegraph selectively from a transmitting station to any number of receivers.

The conversion of the Morse signs into series at the transmitting station as well as the reconversion of the series into dots at the receiving station is accomplished automatically by two instruments, the disperser and the collector, respectively. Sending is carried out in the usual way by pressing down a Morse key for short or long periods.

Fig. 1 shows diagrammatically the connections at the transmitting station. By pressing the key, *1*, a current will flow from the battery, *2*, through the windings of the electromagnet, *3*, the armature of which is fitted with a hook, *4*, to grasp the stop, *5*, on the disc, *6*. The latter is loose on the pivot, *7*, which rotates with a velocity of

about five r.p.s., the friction being sufficient, however, to confer on the disc a tendency to rotate with the pivot. When, therefore, the armature is attracted, the disc, *6*, is released and starts rotating; the stop, *5*, in passing the contact springs, *8*, will close a circuit, including the battery, *9*, and the electromagnet, *10*, mounted on the frame of the disperser. If the key is pressed only for a short time (in order to send a dot) the hook, having released the disc, resumes its normal position, and the disc is stopped after one revolution. Only one impulse is then sent through the windings of the magnet, *10*. If,

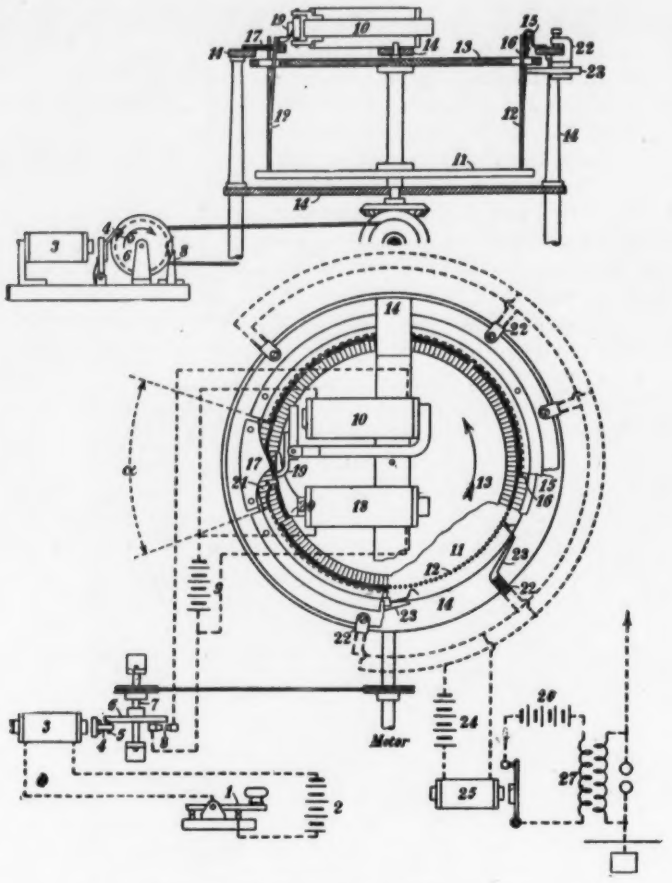


FIG. 1.—CONNECTIONS AT TRANSMITTING STATION.

however, the key is pressed long enough to allow the disc to make several revolutions a number of impulses at regular intervals of one-fifth of a second are sent around the magnet.

The disperser consists of a disc, *11*, to which is fixed a large number of concentrically arranged vertical steel springs, *12*. The upper ends of the springs are free, and are passed through radial slots in a second disc, *13*; their ends are thus allowed freedom in a radial direction only. The two discs are mounted on the same spindle and revolve within the frame, *14*, to which is fixed a ring, *15*, serving as a guide for the points, so that during a revolution they are caused to glide either within the ring, or in the U-shaped groove, *16*, formed by the latter. A piece of the ring corresponding to the angle *a* (Fig. 1), is cut off, and in its place is fitted a piece of bronze, *17*, which bends the ends of the springs towards the pole of the magnet, *18*. This magnet is constantly excited by current from the battery, *9*, and the steel springs are attracted by it. Their elasticity being overcome by the strength of the magnet, and the bronze finger, *19*, being in its normal position, the springs will slide along the pole of the magnet, *18*, and will not be released until they have reached the edge, *20*. On further revolving, they will glide within the ring, *15*. If, on the contrary, the magnet, *10*, is excited, the finger, *19*, fixed to the armature, will be pushed over the pole of the magnet, *18*, and protrude slightly in front of it. Then when the springs pass by this finger, they will be forced from the pole of the magnet, *18*, and on account of their elasticity will resume their vertical position. They will, therefore, enter the U-shaped groove at *21*, and remain in the latter for one complete revolution.

Around the circumference of the disperser a number of contact devices, *22*, are fitted, consisting of two contact springs, *23*, insulated from each other; by the aid of screws these devices may be fastened around the frame at any desired angular intervals. The contact springs are arranged in such a way as to allow the steel springs moving within the ring, *15*, to just clear them, while the steel springs in the groove, *16*, protrude, and therefore in passing will establish contact. When the disperser is working, provided the magnet, *10*, has not been excited, all the steel springs will glide within the ring, *15*, and consequently all the contact devices, *22*, will be open. If, however, a short current impulse is sent through the windings of the magnet, *10*, a steel spring is brought into the groove, *16*, and establishes contact successively at every one of the contact devices. The contact springs are electrically connected, as shown in Fig. 1, and, accordingly, each time a contact is made current from the battery, *24*, will excite the interrupter magnet, *25*, the armature of which will be attracted, causing a current from the battery, *26*, to flow through the induction coil, *27*. On the subsequent opening of the circuit a spark discharge takes place between the secondary terminals of the coil, and a wave impulse emanates from the transmitting station. Consequently, for each current impulse that is sent through the windings of the disperser's magnet, *10*, a number of wave impulses corresponding to the number of the contact devices, *22*, are dispatched. The discs revolving at approximately constant speed, the time intervals between the impulses of such a series will be proportional to the angular distances between the contact devices, and by putting these in different positions around the frame of the disperser, one can vary the form of the dispatched series at will.

At the receiving station the wave impulses strike the mast wire, *28* (Fig. 2), lowering the resistance of the coherer, *29*, and causing the relay, *30*, to become excited. The latter closes the circuit for the tapper, *31*, by which the initial resistance of the coherer is restored, and at the same time a current impulse is sent through the windings of the collector magnet, *32*, which is shunted with the tapper. As the collector is constructed in the same way as the disperser, a steel spring for each arriving wave impulse is brought into the groove of the ring, *33*. The disc to which the steel springs are fastened, like that of the disperser, revolves at approximately isochronous speed, and consequently the angular distances between the springs brought into the groove will be proportional to the intervals of time between the impulses that have impinged upon the mast wire, *28*. A series of, say, five impulses will, therefore, cause five springs to be brought into the groove at angular intervals corresponding to the intervals of time between the impulses. Around the frame of the collector are fitted the same number of contact devices, *34*, as are on the disperser, and, similarly, only the springs

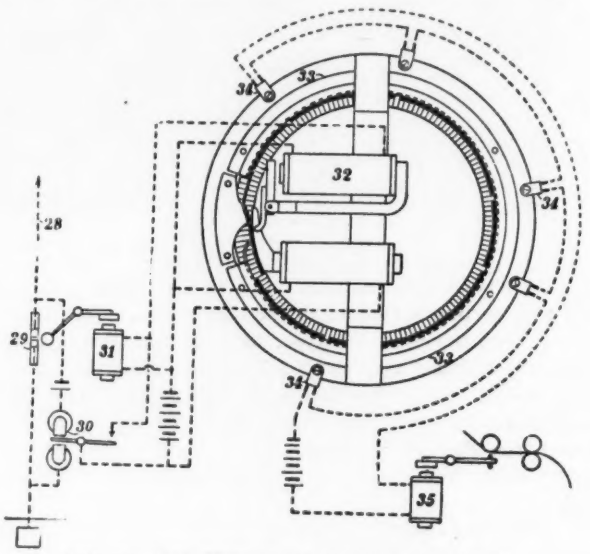


FIG. 2.—CONNECTIONS AT RECEIVING STATION.

moving in the groove will be able to establish contact. The contact devices of the collector are, however, connected in series (Fig. 2), so that a current cannot flow through the Morse apparatus, *35*, until contact is established simultaneously at all the points. If now these points are adjusted to the same mutual angular distances as the steel springs, which, on the arrival of a certain series of impulses, are brought into the groove, then such a group of steel springs will, during the revolution of the disc, cause a momentary simultaneous contact at all the points; a current impulse then flows through the Morse apparatus, and is registered as a dot on the tape. Consequently, a continuous succession of series, dispatched by the trans-

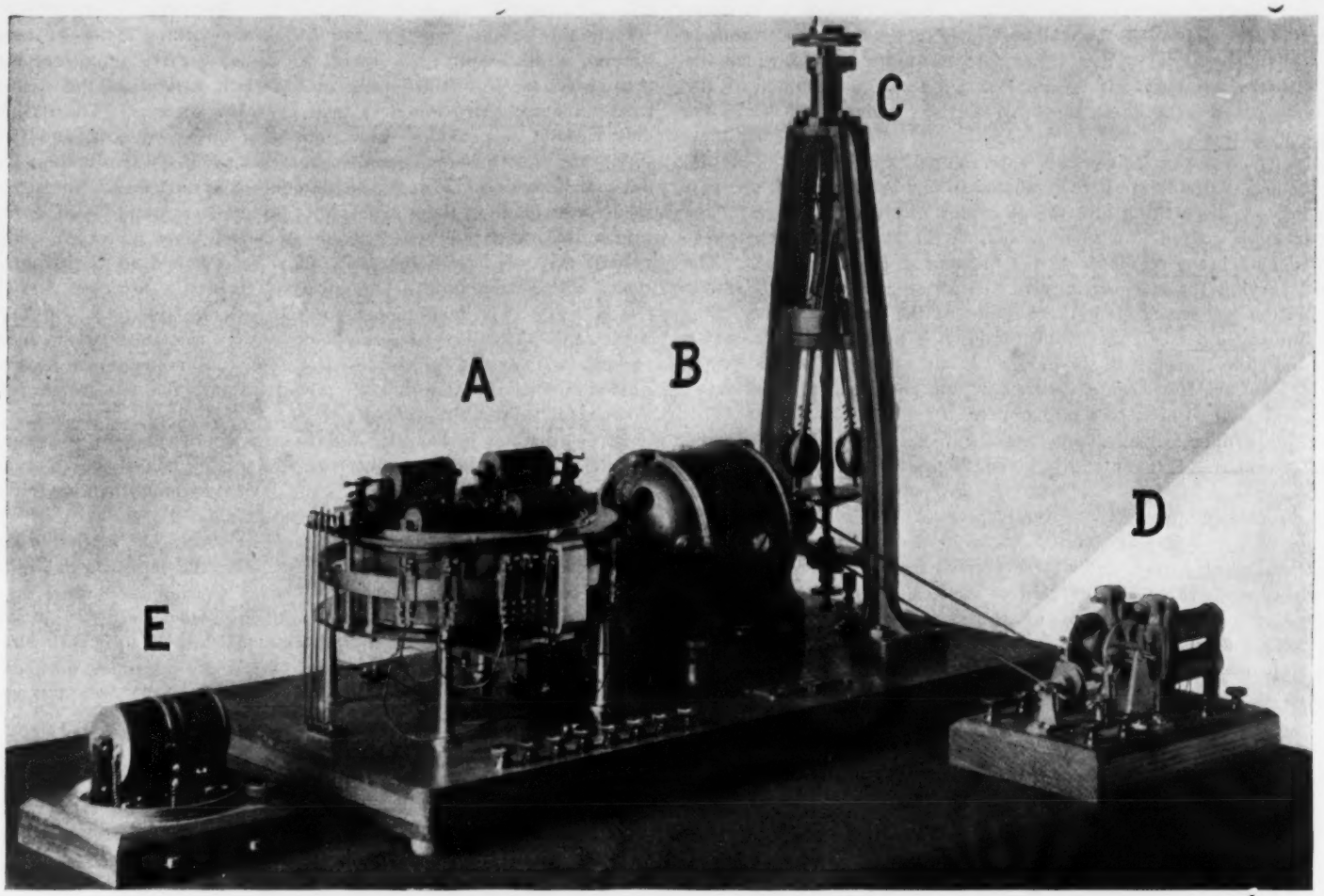


FIG. 3.—INSTRUMENTS USED IN THE EXPERIMENTS.

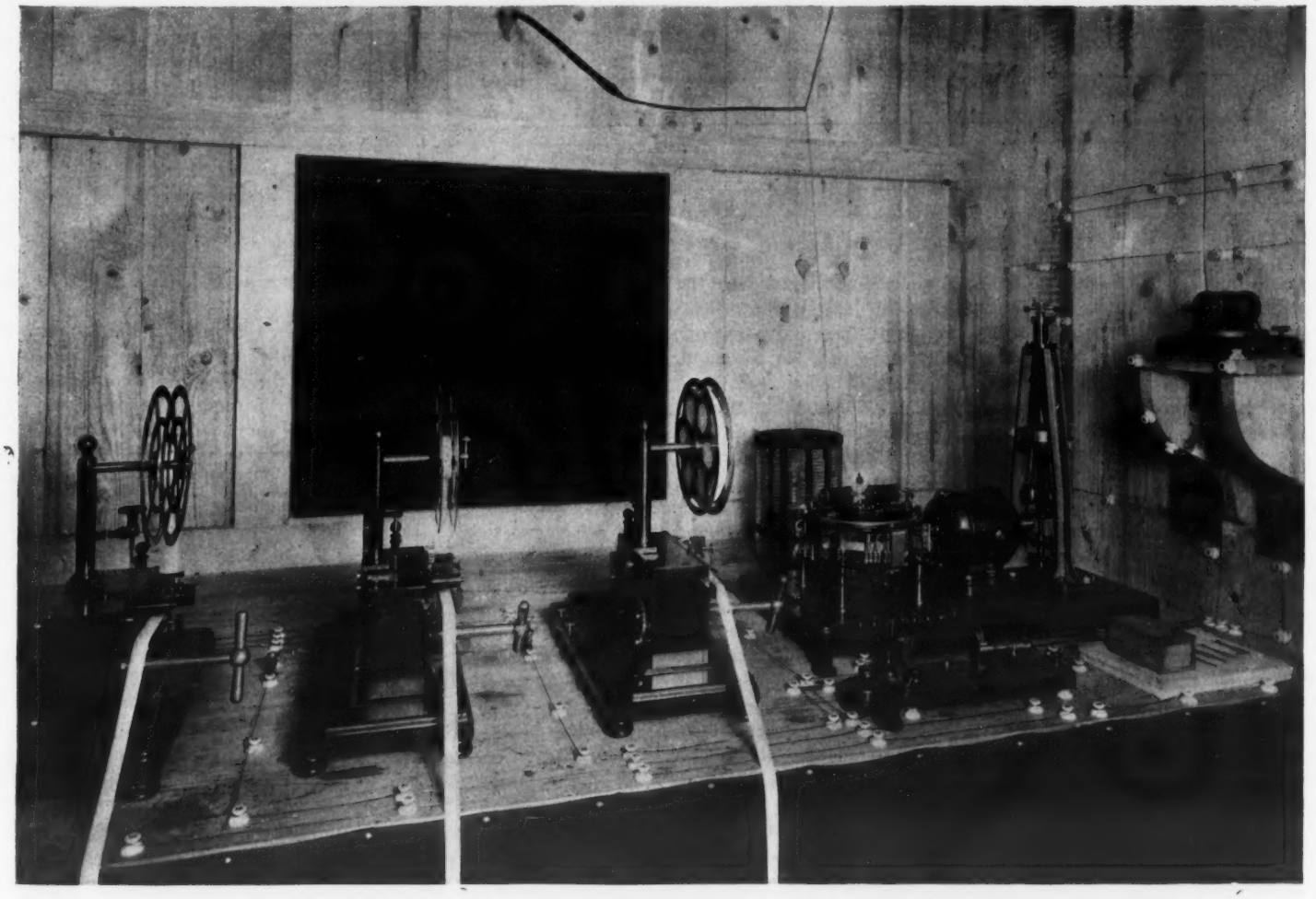


FIG. 4.—COMPLETE RECEIVING STATION.

mitter when a dash is to be transferred, is registered as a continuous row of dots. Series of any other form than the one to which the collector is adjusted, cannot cause a simultaneous contact of the devices, *34*, and, therefore, they will not be registered by the Morse apparatus.

Fig. 3 shows the instruments used in the experiments. The disperser and collector are here combined in one apparatus, *A*, one-half serving for dispatching and the other for receiving messages. The apparatus is geared to a small motor, *B*, the speed of which is regulated by a brake regulator of the Siemens & Halske type, *C*. The disc carrying the steel springs is rotated at a speed of about one revolution per second, and the number of the springs is 400. *D* is the automatic device above indicated by *3—8* in Figs. 1 and 2, and is worked from the shaft of the motor. *E* is a relay, designed for rapid acting, the armature being very slight and the iron core laminated. It works well with 0.1 of a milliampere.

In experiments made, only one transmitting and one receiving station were mounted, but the disperser was provided with three sets of contact devices, *34*, any one of which may be put in connection with the interrupter of the induction coil by means of a switch. The same key can be used to dispatch series of three different forms, and at the receiving station the collector is provided with three sets of contact devices, each of which is connected to a Morse apparatus; these are adjusted in such a way as to correspond with the three forms of series to be dispatched from the transmitting station. Fig. 4 shows the complete receiving station.

The number of impulses in each series is only three, and S_1, S_2 and S_3 at the upper left-hand part of Fig. 5 show diagrammatically the three forms used. Time is represented by the length of the horizontal line, and the impulses by heavy cross strokes. The distance between two of the fine cross strokes represents 0.05 of a second. At the upper part of Fig. 5, to the right, is shown how the series succeed each other when the key is pressed for a long time. By aid of these three series one could telegraph selectively to any of the three Morse machines at the receiving station. The messages arrived very distinct and precise, and appeared exclusively on the tape of the machine for which they were intended. I to III at the lower part of Fig. 5 show three pieces of tape simultaneously unwound from the three Morse machines, when words were sent by the transmitter, in each of the three series, S_1, S_2 and S_3 successively. The tapes show that when one machine was working no signal was registered by either of the other two.

Mr. Bull states that so far as he knows this is the greatest number of receivers that, up to the present, have been worked selectively by wireless telegraphy, but it is evident, however, that they may be increased by varying the forms of the series. The different transmitters and receivers will work equally well if mounted at different stations, and it is quite immaterial whether the distance to be covered is great or short; in these respects the present system possesses a great advantage over those based on electric syntony. The working distance over which these experimnts were carried out was about 100 yards, the energy of the transmitter being small in proportion. Several dispatches can be simultaneously transmitted by this system without interference, but owing to the lack of apparatus this has not yet been done.

It might be thought that the speed of working must be very limited, a dot requiring a series of at least three impulses; but this objection is justified only to a certain extent, as the dashes hardly require more impulses than by other systems. The dashes may without fear of confusion consist of only two dots, and two series are, therefore, sufficient, making six impulses a minimum for the transference of a dash. Although no arrangements for great speed were made in these experimnts, 50 letters a minute were easily transmitted, and this speed could be considerably increased. The system may also be, with little difficulty, adapted to the Hughes type-printing apparatus. The greatest advantage, however, lies in the fact that it is impossible for an outsider to "overhear" or "tap" a message. The lack of secrecy has always been one of the most serious disadvantages of wireless telegraphy and an argument against its commercial adoption, but the inventor thinks that his system presents a solution of the difficulty.

Mr. Bull states he has discovered two ways of rendering messages unintelligible to those unconcerned; one is to make the intervals of time between the impulses in the series so long that the latter become somewhat longer than the intervals between each of the series, which are dispatched in continuous succession when the key is pressed for a dash. This is the case with the series S_3 in Fig. 5. When telegraphing, the series will then overlap each other in a way which makes the message unintelligible if recorded in the usual manner. This is plain from tapes IV and V (Fig. 5), which were simultaneously unwound from two Morse machines, one being tuned and the other connected to the coherer in the ordinary way.

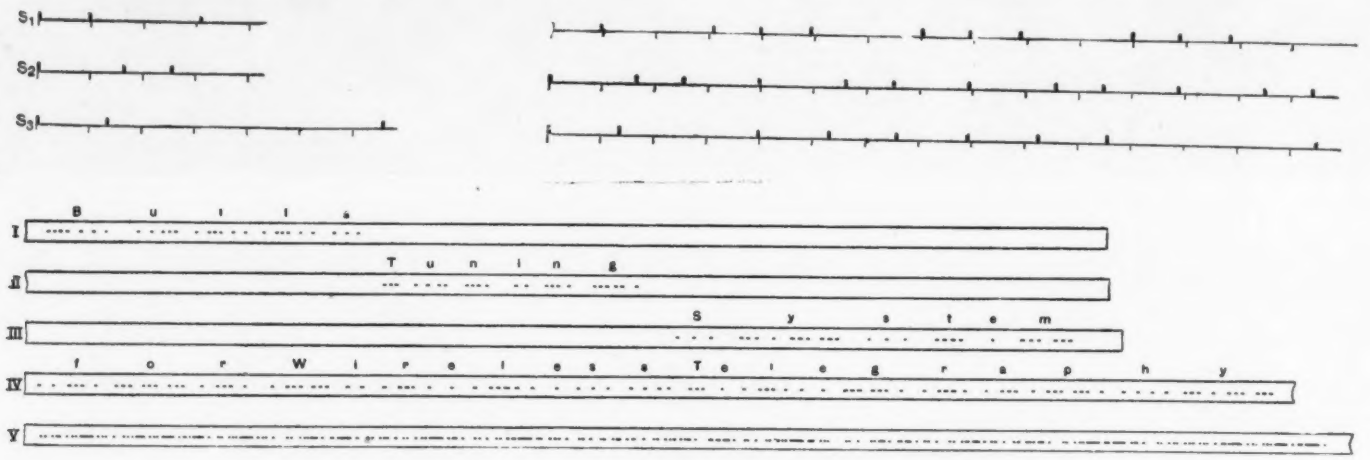


Fig. 5.—Diagram Showing Impulses of Series and Specimens of Tape.

The latter machine, of course, registers each impulse in the order of arrival, and the message appears as on tape V. Tape IV is the identical message recorded by the tuned receiver, and it should be observed that the series in this case only consisted of three impulses. When a greater number is chosen the messages recorded by an ordinary receiver will be still more confused. The other way of keeping the messages secret is to use short series, as S_1 and S_2, in Fig. 5, and to send out in the spaces between the individual dots and dashes of the message a series of a form not affecting the receiver telegraphed to, but nevertheless resembling the series to which the receiver is tuned; this can be done by a very simple automatic device. In such a case an ordinary wireless telegraph receiver would give an unbroken row of dots, quite impossible to decipher, as the two forms of series could not be separated.

Exports of American Manufactures.

Exports of American manufactures show a marked increase in the calendar year 1902 as compared with 1901. The total value of the 1902 exports of manufactures, as shown by the figures of the Treasury Bureau of Statistics, is $410,650,967, against $395,104,030 in 1901, an increase of 15½ million dollars. Nearly all the important manufactures entering into export trade show an increase, the chief exceptions being iron and steel and refined mineral oil. Iron and steel manufactures show a decrease of over 4½ million dollars and mineral oils a reduction of 4 millions. Copper manufactures showed the largest gain, 12 millions.

The Electrical Resistance of Bearings.

BY A. E. KENNELLY AND C. A. ADAMS.

IT is generally known that a film of oil envelops a shaft rotating in a well-lubricated oil bearing. It is not, however, generally known that a shaft may be highly insulated electrically from the bearing by this film of oil, and that the oil film is capable of withstanding a comparatively high electric pressure.

We have found that in small sizes of dynamo machines there is frequently a very considerable resistance between the shaft and the pedestals or base of the machine, while the shaft is in rotation. When the bearings are in good mechanical condition, it seems that this resistance amounts to electric insulation. Also that this insulation is maintained throughout a wide range of speed. In other words, the insulation appears to break at speeds that are very low by comparison with the normal.

We have made some measurements upon the resistance in the bearings of an Edison bipolar 125-volt, 6-kw machine, having a normal speed of about 1,800 r.p.m. This machine has been in regular testing-room service for about ten years. When the armature is at rest, the resistance in the bearings is practically nil, the shaft resting in good electrical contact with the bearing metal. Above a speed of about 100 r.p.m. this short-circuit in the bearings disappears, and the resistance between shaft and pedestals, i. e., the resistance of both bearings in parallel, amounts to about 4.4 megohms, as measured by the insertion of a direct-current, 125-volt voltmeter, according to the series-voltmeter method, and using a direct-current pressure of about 120 volts. This represents a resistance of 8.8 megohms, on the average, in each of the two bearings, and since the bearings are approximately 5 in. long (12.7 cm), with an internal diameter of 1⅛ in. (2.86 cm), the surface in each bearing is about 114 sq cms, representing an average insulation of about 1,000 megohms per sq cm of oil surface. The bearings are of the usual self-oiling type, with two revolving brass oil rings in each.

This insulation is maintained under very considerable lateral pressures on the shaft. An altogether abnormal lateral pressure has to be exerted on the rotating shaft in order to break the insulation.

The insulation, as measured in this way, was found to break down periodically, owing to the accidental contacts between the brass oil-rings and the sides of the bearing slots in which they travel. When the rings were lifted, to remove this source of disturbance, it was found that the insulation entirely disappeared. The insulation of the shaft was not restored until all of the four rings had been released again and set in motion. In this manner the importance of the oil-rings, in maintaining an adequate flow of oil through the bearings, is readily demonstrated.

Similar experiments with new dynamo machines, in which the bearings had not had sufficient time to wear down to the normal condition of shape and surface, showed only a more limited degree of this insulation.

After the brass oil-rings had been replaced with insulating oil-rings of fibre having the same dimensions, the insulation of the shaft during rotation remained steady and permanent. The insulation does not break down under the influence of 500 volts direct-current pressure, as applied through a 600-volt voltmeter. The insulation resistance as measured in this way is no less than when the pressure of 120 volts is employed.

When a pressure of 1,670 volts alternating was similarly applied, the insulation in the bearings did not appear to break down, but the apparent resistance in the bearings was markedly reduced. It is not at present clear whether this is an actual diminution of resistance in the oil under the alternating-current pressure, or whether it is an effect due to capacity or polarization.

The sudden change with speed of such a dynamo shaft, from complete grounding to relatively high insulation, would make an effective lecture experiment.

The electrical resistance of a bearing, as studied in this way, may also be of considerable use in analyzing the mechanical condition of the bearing.

We are indebted to the assistance of Mr. S. E. Whiting in the course of these experiments.

The Industrial Efficiency of Germany.

In an article in the *World's Work* for February, on German business methods, Mr. Louis J. Magee, an American electrical engineer well known in this country, who has been prominently associated for some thirteen years with the Union Elektricitäts Gesellschaft, of Berlin, says:

I think the Germans possess pre-eminently the following traits:

First, thoroughness—the mastery of facts in the preparation of a basis for action; elaborate study precedes decision in most financial and technical work; high standard of education.

Secondly, unquestioning obedience to the existing laws—willingness to follow rules; a subordination of personal will to the established method. This is the good side of their lack of independence.

Thirdly, honesty throughout business life is the general rule. Comparatively little business depends upon the use of questionable methods.

In technical progress as well as in general business methods the Germans are keen for progress. All branches of business have their trade journals, which are eagerly watched, and scores of clever observers are traveling about the world learning much from their neighbors. Only thirty hours after the American astronomer, Perrine, had informed the world-central astronomical office of the discovery of a new comet, a French astronomer telegraphed his news of the same celestial visitor. This faint light of only the ninth magnitude found searching eyes on both sides of the Atlantic. How much more must the great worlds of business and industry on either side of the ocean be waiting for new hints of progress.

An American professor, after visiting a large technological institute in Germany, told me that the school and its equipment was ahead of anything at home. When this compliment was repeated afterward to a prominent instructor in the institute, he replied: "Why, that is exactly what I said of your technical schools after my trip to America, and that is the only way I could get the money to make ours what it is to-day."

That Germany's technical army is marching forward in good form is a generally accepted fact. The American terror is before their eyes, but they have elements of strength which may keep them up against all competitors in certain lines.

Banquet to Marconi in Canada.

A banquet was given to Mr. Marconi at Montreal last week by the directors of the Canadian Marconi Company on Thursday night. Sir William Mulock, responding to the toast, "The Canadian Government," gave voice to the strong prevailing sentiment in favor of a liberal subsidy for the Marconi system of wireless telegraphy.

Mr. Hugh A. Allan, of the Allan Steamship Line, urged the necessity of some system in aid of navigation on the St. Lawrence route and outlined the means whereby the safety of vessels would be assured. F. W. Morse, of the Grand Trunk system, asserted that the practical use of wireless telegraphy trains working at the rate of 60 miles an hour had been demonstrated on the Grand Trunk and that Marconi's system would prove more useful to the railways than even the telegraph or telephone.

Representatives of the government and all the most prominent interests in the Dominion were present at the banquet to do honor to the inventor. Mr. Marconi acknowledged the great debt he owed to Canada for its timely assistance and said that it was only reasonable to expect that the coast commercial messages by his system would be greatly reduced over the contract price named on the government franchises of his company, viz., 10 cents per word.

The Canadian Marconi Company is capitalized at $5,000,000. The parent company retains control in this case also. The company owns the Glace Bay transatlantic station and is preparing to install a number of other stations. It also owns the Canadian rights to Marconi's inventions, including the equipment of ships having Canadian registry. It has under consideration plans for the introduction of its system along the Pacific coast and to the Canadian Yukon. It will establish works for the manufacture of instruments either at Montreal or Toronto, including a school for the instruction of operators. Negotiations are in progress with the government for a system of subsidized stations on the eastern coast.

The Economic Value of Testing.*

By Prof. Geo. D. Shepardson.

The aim is to show that it would be a capital investment to put more money into buying accurate instruments and to have men competent to use them. It goes without saying that the manager of a manufacturing plant should know how much product he manufactures, how much it costs per unit, how many units he sells, how many are lost somewhere between the raw materials and the finished product, how many are lost or stolen between the factory and the customer.

Applying this to the operation of a central station for the manufacture and marketing of electrical energy, it is desirable and economical to keep systematic record of the amount of raw material used, namely the amount of fuel, water, oil, carbons, lamps and other supplies; the output of the factory, namely, the kilowatt-hours produced; the amount sold. The relation between amount of raw material and the station output furnishes a basis of comparison with the performance of other factories, and shows whether the cost of manufacture is reasonable.

The shrewd manufacturer desires to know not only whether he is conducting his operations about as economically as do others, but he wishes to know whether he is working as efficiently and as economically as possible. He is not satisfied to earn a ten per cent. dividend because that may be the average performance of his neighbors, but he wants to know whether he can raise that ten to fifteen or to thirty per cent. In order to accomplish this he must have detailed information about the actual working of his plant.

The portion of the income which every wise company sets aside for betterments can be expended most advantageously when the manager knows the condition and efficiency of every part of his system, so that he may be confident that $100 spent in one place will effect greater economy or other improvement than the same amount spent otherwise.

Information can be obtained only by testing. Every station does such testing to a less or greater extent. Where one man is superintendent, engineer, fireman, operator, lineman, trimmer, wireman, meter man, collector and general trouble man, the amount and quality of testing is necessarily limited. In larger stations where the responsibilities are differentiated, greater attention can be paid to details, and a larger amount of testing is practicable. The larger companies find it practicable and economical to maintain an elaborate testing department with one or more experts who devote their chief energies to systematic examination of all the parts of the business, seeing that everything is kept in the best possible condition. The syndicates which are operating central stations in different parts of the country find it pays well to maintain a competent and well equipped testing department. Many of the smaller independent companies are finding it profitable to engage the services of consulting engineers to make periodical examinations of their properties for the purpose of indicating leaks and economies. It is possible to err on the side of too much testing and superintendence, but actual cases of this sort are very rare indeed.

In most stations, the testing can be done with reasonable satisfaction by the regular employees without seriously adding to their duties or responsibilities, and without imposing an alarming expenditure for equipment. When the necessary apparatus is installed ready for regular use, the ordinary employees can take the readings after a small amount of instruction and with proper care. The instruments should be checked at intervals not more than a year apart, by comparing them with other instruments known to be correct. This can be done by sending them to the maker or to a laboratory of good reputation. Most of the technical schools now have sets of standards which are correct within very close limits and with which other instruments may be compared at small cost.

A considerable part of the testing can be carried on without any instruments other than a good eye directed with judgment and a knowledge of what is correct modern practice. Too much importance cannot be given to frequent and thorough inspection of the entire system by the superintendent or by some other person whose eye will notice apparent defects. An example may be noted where a 220-volt plant was so heavily overloaded that the owners were about to install larger machines. A young man who had not yet completed his technical course at the state university was sent to look over the situation; by careful inspection he was able to locate poor insulation. After overhauling the lines he increased the number of lights installed by about one-third, and even then the load was one-fifth less than before his arrival. In the same plant, by the careful use of a portable voltmeter, he was able to locate a number of bad splices and to show where the circuits should be strengthened with greatest profit. It is not necessary to send away for an expert in order to locate poor work where the lineman has made a "temporary" job in an emergency with the temperature below zero and a Dakota zephyr gently playing about his ears; nor is it difficult to detect lines crossed and lying on the cross arms, resting against trees and iron roofs and similar violations of insurance rules.

Every engineer recognizes the prime importance of feeling his bearings to detect any signs of undue heating. The electrician can also detect poor electrical bearings in similar manner. Dynamo operators make a practice of feeling various parts of their machines to see that the brushes, holders, studs, switches and other contacts make good connection and keep cool. The same vigilance should extend to the switchboard. Poor service due to excessive drop in the lines may frequently be traced to loose and poor contacts in switches and fuse blocks. Unless the fuses have hard terminals, they expand and squeeze out from under the screws and then become loose. The insurance rules call attention to this point, but fail to note that the screws in the switches as well as on fuse blocks work loose and often introduce so much resistance as to lower the voltage quite appreciably. In such cases local heating always occurs unless the circuit becomes opened entirely.

Flexible cables often heat excessively when soldered into terminal lugs, due to the fact that the individual wires were not properly cleaned and tinned before soldering, so that only the outside layer of wires are connected and these have to carry the whole current.

An occasional inspection of fittings and conductors at time of full load will often locate unsuspected sources of trouble.

In order to illustrate the actual value of testing, a few instances will be quoted from a collection of data gathered from central stations and isolated plants in various parts of the country, showing conditions that actually exist where there is little or no systematic testing.

One of the first sources of loss may be found in the boiler room, where the fuel may have been exposed to the weather and is in poor condition for use. The appearance of the smoke will indicate something of the quality of the firing. In one case the correction of leaky boiler settings and insufficient stack, which had affected complete combustion, effected a saving of twenty per cent. of the fuel bill.

In another case, proper cleaning of the feed water heater and of the boiler cut down the fuel consumption by thirty per cent. Grates not suited to the fuel, poorly proportioned grate area, poor boiler setting, poor draught, poor water, cold feed water and dirty flues are as a rule discoverable by the skilled eye without many instruments. Periodical cleaning and inspection of the boiler will increase efficiency and diminish accidents. Steam gauges are not uncommonly inaccurate. Track scales for weighing fuel and ashes, thermometers for checking temperature of feed water are of great importance, and the meters or tanks for measuring the amount of water evaporated will generally pay for themselves. Insufficient covering of steam pipes may be detected by the eye and hand. Excessive drop in steam pressure between boiler and cylinder will appear from the indicator card or from the difference between pressure gauges at boiler and at engine. A calorimeter for determining quality of steam is neither expensive nor very complicated in operation. The intelligent use of the indicator will detect improper setting or worn condition of valves. In one instance poor valve setting increased the fuel consumption forty per cent.; the engineer had an indicator, but did not know how to interpret the cards nor how to apply the remedy.

Tests of several stations operated by one of the largest corporations in the West showed that the inefficient heaters in two stations were costing more than $2,400 and $2,500 respectively each year of operation, and the saving effected by changes paid a good interest on the investment and went far toward the maintenance of the testing department.

Improper condition of the engine governor or uneven belt will appear in the unsteadiness of the lights. Dirty condition of the

* Abstract of paper read before the Northwestern Electrical Association.

dynamo and improper setting of brushes, which are liable to induce trouble, will be detected by visual inspection. Poor regulation of voltage, one of the most frequent sources of trouble and loss, may be caused by speed variation, by improper compounding of generator, by inattention to the regulator and voltmeter, by overloading or poor design and construction of the circuits.

On the switchboard the most common sources of loss are the integrating wattmeters and the voltmeters. In a surprisingly large number of stations the switchboard wattmeters are like snakes in Ireland; there are none. Correct integrating wattmeters are of the greatest importance for registering the output of the factory. By comparing the fuel consumption with the kilowatt-hour output the superintendent has at once a means of determining the efficiency of his station operation. It gives him records for comparing his work from week to week and thus for detecting serious changes in the efficiency of the station as a whole; it gives him the data for comparing the performance of his station with that of other stations and indicates how much improvement he may reasonably expect from his equipment; it gives him a means of noting any excessive discrepancy between station output and the energy registered by the consumers' meters; it gives him a means of comparing lamp breakage with service rendered, and so gives a check on poor lamps and on poor regulation; it gives him a record of the changes in daily, monthly and yearly load.

An interesting illustration of the value of station wattmeters was that quoted by Mr. Wirt before this Association last January: During the year ending June 30, 1900, the station wattmeter showed 729,923 kilowatt-hours delivered to the commercial circuits, while the consumers' meters read in the aggregate only 309,001 kw-hours, or 42 per cent. of the station output. This must have opened the eyes of the superintendent, for the next year the station wattmeter showed 671,006 kw-hours, while the consumers' meters registered 393,223 kw-hours, or 58½ per cent.; thus the paying load was increased while the station output was diminished. Another station reported a line efficiency of 75 to 90 per cent., showing a still better performance.

Care needs to be taken that the station wattmeters are properly installed and are properly calibrated. Station wattmeters are sometimes affected by the magnetic fields due to bus-bars or other sources; sometimes the jar makes them run fast. Direct-current instruments may be checked by ammeter and voltmeter without difficulty. With alternating currents, it is necessary to get a non-inductive load, such as a bank of incandescent lamps, or else to have a correct wattmeter for checking purposes.

When the station is not supplied with wattmeters, the lack may be partially offset by readings taken every half hour from the switchboard ammeters and voltmeters. From these the output of a direct-current station may be computed from hour to hour and for the whole run. It is desirable to supplement the daily or hourly wattmeter readings by the voltmeter and ammeter readings. In an alternating-current station the product of volts and amperes will generally be greater than the true watts delivered. In any station it is desirable to preserve a record of voltage, either by readings every half hour, or, better yet, by a continuously recording voltmeter.

The consumers' wattmeters naturally come in for consideration at this point. It is now generally recognized that all customers should be on meters. Flat-rate customers almost invariably have the best of the company. The rates are generally lower than meter rates; customers have little incentive to economical use of current. One notable case maintained for seven years a flat rate of one dollar per month for each residence, irrespective of number of lights. That was a municipal plant. In one case the load was reduced fifty per cent. by compelling the use of meters, thus allowing the taking on of additional load without increase of equipment other than meters. Experience shows that the reduction of load by changing to meters does not involve a corresponding decrease in revenue.

Wattmeters need to be purchased with some discretion, and need to be tested for accuracy at least once a year. They should in every case be tested before being placed in service and when changed from one location to another.

One superintendent reports that when he took charge several years ago it was quite common to find monthly meter charges of only a few cents, even in winter time; since cleaning and correcting meters, and establishing a minimum monthly charge, the improved financial showing has earned his salary several times over.

It seems not uncommon to find meters running from 10 to 40 per cent. slow on full load, and requiring considerable load before starting. Most stations would increase their income by using meters with greater accuracy at small load. In many cases this can be accomplished by using smaller meters. By using induction meters on alternating-current circuits, the light load registration has been greatly improved. It is desirable to have all meters of the same kind, especially in smaller stations, which cannot afford to keep a meter specialist. Cases are reported where customers buy their own meters, and where every different kind of meter on the market adds to the trials of the superintendent; it is needless to say that choice of meter, and preferably the ownership of same, should rest with the company.

Meters should be cleaned and tested at least once a year. This should be done during the summer, both because the station men have more time, and because the lighting bills are so small that consumers do not notice the change. No sane meter man would choose December as a proper time to clean a meter that was found to be 40 per cent. slow.

Good voltmeters are even more essential than station wattmeters. The ammeters may be only current indicators and their accuracy is of only secondary importance. But a good voltmeter, properly used, is vital to the satisfactory operation of the plant, and it should be accurate within at most one per cent. The voltmeter is the gauge by which the pressure is regulated, and proper regulation is the measure of satisfactory service. The voltmeter should not only be accurate in itself, but it should indicate the voltage at the main center of distribution, or at the point of important consumption. This may be accomplished by bringing pressure wires back to the station, or by using some sort of compensating device which will correct for drop in the lines. Good station instruments should be supplemented by accurate portable instruments, by which to test conditions prevailing on the circuits. Good portable instruments are as essential as those in the station if close regulation is to be attained.

The importance of close and correct regulation of voltage is not sufficiently appreciated. Lamp makers have insisted for years that the life of a lamp is greatly shortened by excessive pressure; that an increase of three per cent. above normal voltage cuts off the life of an incandescent lamp by one-third, and that an increase of six per cent. in voltage takes away about seven-tenths of the life of the lamps. High pressure not only shortens the life of the lamps, but it educates consumers to expect 30 to 50 cp from a 16-cp lamp, so that much dissatisfaction follows the correction of the voltage. Moreover, high pressure increases consumers' bills out of all proportion, an increase of 10 per cent. in the pressure causing an increase of more than 20 per cent. in the watts taken by the lamps, while the cost of lamp renewals is appalling. Low pressure is almost as bad as high pressure, for while the lamps last much longer they give so poor light that the people resort to oil lamps, candles and anathemas.

Excessive high or low pressure is often experienced in various parts of the system when the station operator believes that the pressure is normal. The station voltmeters frequently read low, so that the pressure is actually higher than indicated. Reports at hand show station voltmeters reading from 1 to 20 per cent. low, only a very few reading too high. The general tendency is for ammeters and voltmeters to read low as they age. Comparatively few stations seem to be provided with portable voltmeters. These are essential for checking line losses and distribution of load. No matter how skillfully the circuits may have been designed, the load is sure to change from the conditions assumed, some circuits will be overloaded while others are light. The result is the drop varies in different parts of town and at different hours in the day. Poor service means dissatisfied customers and slow increase of business. The use of a portable voltmeter will show what lines have too high voltage, what ones are too low; by a systematic study of the situation the causes may be located. A few cases may be cited to illustrate. One company was renewing about 1,000 lamps per month, about one-tenth of the entire number installed, on account of poor regulation caused by improper balancing of load on the different feeders, and by not tying secondaries in the business district. Another case of poor lights was located by a portable voltmeter showing 128 volts where 110 was intended, the trouble being traced to some intelligent wireman who connected service wires to the pressure wires running back to the station. Poor service on a secondary

four blocks long, with a transformer at each end, was found to be due to the blowing of the primary fuses of one transformer. Other cases of poor service were traced to poor splices not soldered, but carefully taped, to small mains, to improper interior wiring. In two adjacent stores connected to the same transformer the full load voltages were found to be 93 and 102 respectively. In a three-phase plant with power house five miles from town a voltage variation of 15 per cent. in different parts of the town on moderate load was corrected by transferring part of the load to other legs of the circuit, by installing heavier transformers and heavy secondary circuits in the crowded district and by moving the smaller transformers to the thinly lighted districts. When my informant took charge of this plant there was no portable voltmeter in the county, and the only station voltmeter was five miles from the load. The purchase and intelligent use of a portable voltmeter quickly indicated the causes of dissatisfaction and the remedies became plain.

A supply man reports a case where the incandescent lamps were not giving satisfactory life; queries about the regulation were always answered that the regulation was first class and that the lamps gave good light. A personal visit developed that the engineer had no voltmeter at all and did not wish any, for he could tell by his eye when the lamps were at proper voltage. As a corroboration of his judgment, the supply man tried his voltmeter and found that the 104-volt lamps were operating at 116 volts.

One superintendent reports his success in determining the distribution of his load by putting a maximum demand meter into the primary circuit of transformers or into branches of secondaries. By moving this instrument from place to place, cutting it in at the fuses or wherever convenient, he is able to locate the causes of dim lights.

Since many conflicting statements are made by lamp agents, each of whom has positively the best lamp on the market, and, in fact, the only one that an up-to-date station can afford to use, the only wise thing to do is to make tests, or to secure the results of impartial tests made by others. Many central station men are suspicious of photometers, feeling that only experts can use them correctly. As a matter of fact, it is far simpler than an engine indicator, and with a good voltmeter and careful operation will easily give results reliable within two per cent. It is also an open secret that lamp makers are apt to furnish a more uniform selection of lamps at the same rate to stations known to have photometers for testing, and that they dispose of irregular stock to stations which do not know whether they get what they want or not. (This is not saying anything against the lamp men, for if they do not dispose of irregular products profitably, the cost of good lamps must increase accordingly.) As an example, a recent test of 35 lamps furnished to a station without a photometer showed only 6 out of 35 which came between 13½ and 17 cp, the others ranging all the way from 9 to 20 cp. Remarkable tales are told of the performance of bargain lamps sold by drug and department stores where the stations do not furnish renewals free or at a cost below competition.

The importance of close regulation of voltage is emphasized at almost every electrical convention, yet poor regulation is one of the most common faults in station practice. A recording voltmeter on an important feeder from one of the largest stations in the northwest, and operated by one of the large syndicates, shows a pressure fluctuating from 112 to 140 volts on a secondary supposed to give 110 volts. The effect on the lamps and on the cost of lamp renewals may be imagined. Photometric tests of 45 lamps from one building served by this feeder showed a range from 4.1 to 15.7 cp, with efficiencies running from 3.27 to 7.7 watts per candle, the lamps having been bought for 16-cp at 3.1 and 3.5 watts per candle.

In securing equipment for methodical testing, it is well to keep in mind that satisfactory service is more important than efficiency, for "the better the service, the more customers; and the more customers, the cheaper the cost of production." The most important testing instrument, therefore, is a portable voltmeter known to be accurate within one per cent. With this the station voltmeter can be tested and then be retained, corrected or replaced. The engine indicator is of next importance, for it is most likely to locate causes of poor economy. With this should come a tachometer or a speed indicator. Then should come scales for weighing fuel, switchboard wattmeters for each class of circuits. Then a portable ammeter accurate within about one per cent.; for measuring direct currents, this may be a "round-pattern" instrument provided with a number of shunts from one ampere up so as to obtain a variety of ranges; for alternating currents an ammeter about 15 amperes capacity and one about 50 or 100 amperes capacity will generally answer; then add water meters and thermometers and calorimeter and pump register; then add photometer, recording voltmeter; then for an alternating current station add two or more wattmeters, one for testing watt consumption of incandescent lamps, and one for testing meters, motors and arc lamps. There is a difference about the relative importance of the instruments, and the order in which they should be secured, but the above order will be about right.

The question of the extent to which a station of moderate size should afford to maintain regular testing is an open one. A consulting engineer of excellent reputation, who has been helping better the performance of central stations, says: "My procedure is to get the owner to mail me daily an hourly record of coal consumption, feed water consumption and kilowatt-hour output as measured by the integrating wattmeter; also kind of coal, temperature of water, steam pressure, and any readings of ammeters, voltmeters, indicating wattmeters, steam indicator diagrams, etc., which would affect the economy of operation; also a daily record of load factor as measured by wattmeter; that is, the ratio of average load to maximum load for one hour. By preparing an hourly record, operators get down to business and educate themselves on the subject of pounds of coal per kilowatt-hour. I will not take charge of a station using old style or 133-cycle transformers or any decidedly inefficient apparatus, nor unless there is provided a Weston voltmeter in reserve, an indicating wattmeter, thermometers, a cold water meter, coal scales, an engine indicator, a counter on pump, and keep these instruments calibrated. The monthly financial statements must also be furnished. Some of the results now obtained are excellent and the improvements most satisfactory. Systematic cleaning, inspections, tests and hourly records are to my mind necessary to pay maximum dividends."

New Canadian Niagara Power Enterprise.

The Ontario Government has granted a franchise to the Toronto Niagara Power Company which gives this company the right to develop 125,000 horse power in Victoria Free Park. The Government was governed in its action by a recommendation of the Park Commissioners. The franchise permits the construction of an intake, a wheel-pit and a tunnel. It is thus clear that the development of the Toronto Niagara Power Company will be along plans very similar to those of the Canadian Niagara Power Company.

The intake of the Toronto Niagara Power Company will be located between the forebay of the Ontario Power Company and the inlet of the Canadian Niagara Power Company. As it will be further up the river than the works of the latter company, it will necessitate the construction of a longer tunnel. This tunnel will extend under the riverbed, and the portal will be practically behind the sheet of water of the Canadian Falls. For the development of 125,000 hp the section of the tunnel is likely to be slightly larger than the tunnel of the Canadian Niagara Power Company, while the wheel-pit will probably be a little longer. From $3,000,000 to $5,000,000 will be expended on the work, which will take about three years in building. For this reason it will be a very long time, probably five years, before the scenic features of the Canadian park are restored.

When the Toronto Niagara Power Company applied for its franchise, the engineers of the Canadian Niagara Power Company pointed out that the construction of an intake above their inlet would effect serious injury to their installation by lessening the supply of water. The Government had expert engineers make a full investigation of the probability of such an occurrence, the result being that in granting the franchise the Ontario Government makes it compulsory on the Toronto Niagara Power Company to erect weir dams for the protection of the Canadian Niagara Power Company, bonding it in the sum of $25,000.

It is understood that the Toronto Niagara Power Company will commence work this spring. The principal promoters of the new company are Frederic Nicholls, Lieut.-Col. H. M. Pellat and William McKenzie, of Toronto. One of their principal arguments to secure the franchise was that Canadian power should be developed by Canadians for Canadians, and it is stated that the company will be all Canadian.

Vicarino Car Lighting System in France.

The accompanying illustrations refer to a French system of car lighting known as the Vicarino system, which is being exploited by the Compagnie Generale Electrique of Nancy, France. One of the main features of the system is the employment of two sets of storage batteries, one of which is being charged while the other is on the lighting circuit. This system is now installed on a number of cars of the Chemin de Fer de l'Est.

The apparatus consists of a dynamo suspended under the floor of the car connected with the axle by means of a belt; two storage batteries of 16 cells each grouped in two boxes; and a switchboard carrying the circuit switches and the automatic regulating apparatus. There is also an arrangement of switches whereby when the train is in motion the dynamo may also be thrown on the lighting circuit, at the same time continuing to charge the batteries. The batteries are automatically thrown into the dynamo circuit when the voltage of the latter reaches a given figure. The dynamo also furnishes to the battery on the lamp circuit a portion of the current which it generates, the amount depending upon the output of the machine and the state of charge of the first battery, this current passing through a regulating resistance by means of which the voltage of the battery discharging is maintained constant.

When the train stops, the circuit-breaker throws the two batteries whereby when the voltage of the dynamo passes a certain limit, a resistance is thrown into the exciting circuit, thus avoiding an abnormal charging current.

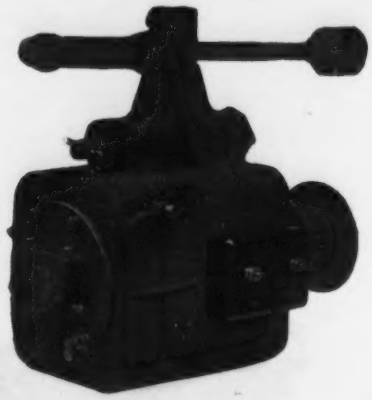


FIG. 3.—VIEW OF GENERATOR.

The dynamo brushes are automatically displaced by 180° when the motion of the train is reversed. The brushes are of carbon and are secured to a cast-iron disc; this disc is movable about its axis

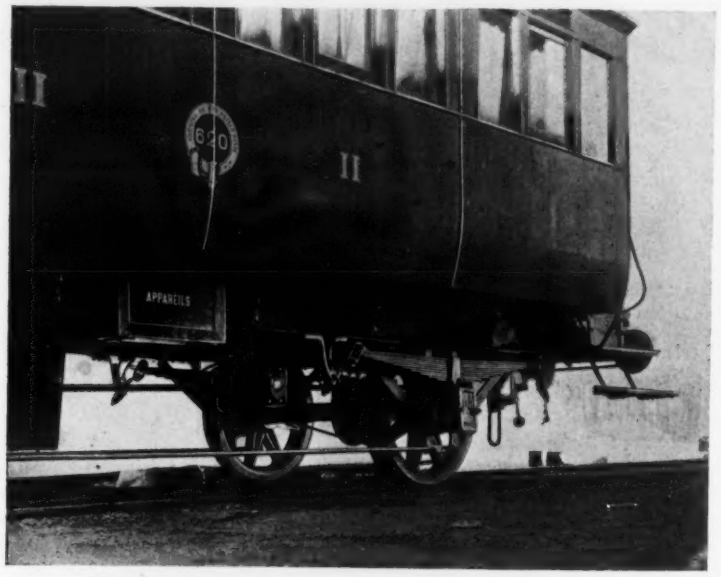


FIG. 1.—ELECTRICAL APPARATUS UNDER CAR.

in parallel and introduces into circuit a portion of the regulating resistance mentioned above. By this means there is avoided the fluctuation in voltage which would otherwise result through intro-

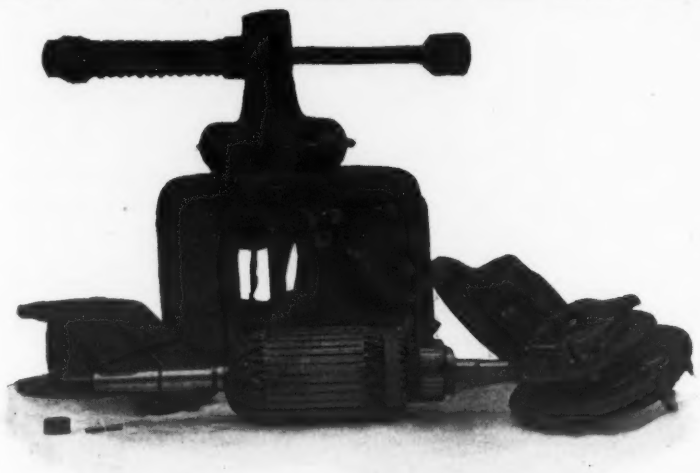


FIG. 2.—GENERATOR DISSEMBLED.

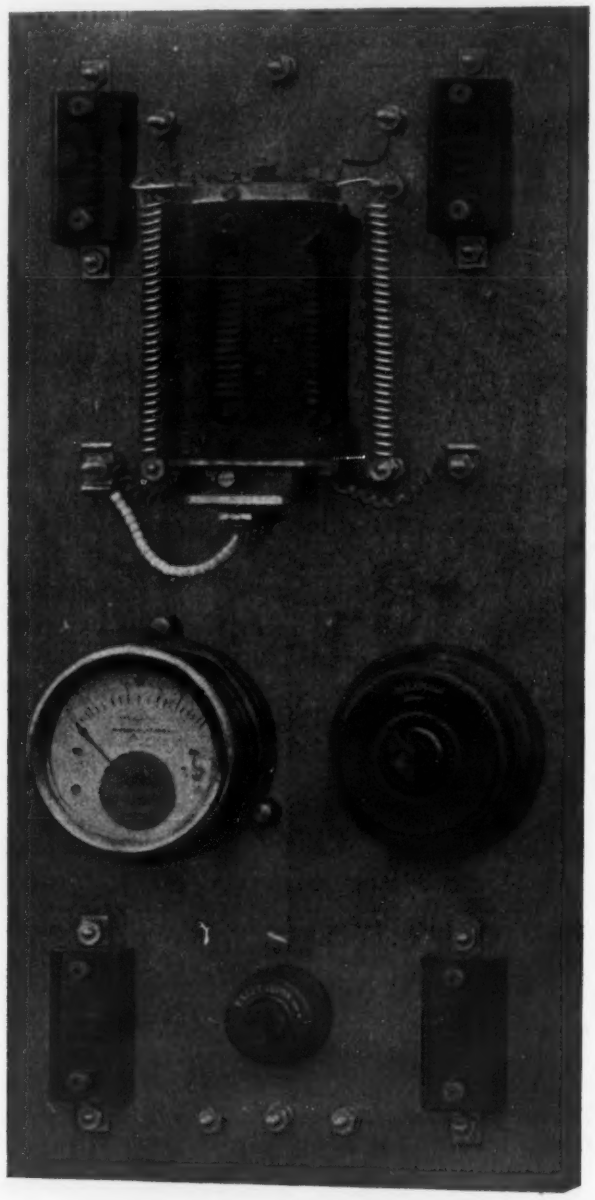


FIG. 4.—VIEW OF SWITCHBOARD.

ducing into circuit the second battery. By means of a switch one battery can be cut out of the lighting circuit and the other cut in, or all of the lights extinguished, or the two batteries thrown in parallel on the dynamo. There is also an automatic arrangement and is held in a normal position by a stop. When the direction of motion of the armature is reversed, the friction of the brushes causes the disc to take a new position at an angle of 180°, where it again brings up against a stop. The dynamo cut-out, which acts

when the voltage of the dynamo falls below a given point, has two windings, one being a fine wire shunt winding connected to the terminals of the dynamo, and the other a large wire winding through which the armature current passes. The windings act normally together, but in opposition should current pass from the batteries to the dynamo.

Voltage Regulation.

In a paper read at the recent convention of the Northwestern Electrical Association, Mr. H. C. Wirt considered the subject of voltage regulation of direct-current circuits. In the early days of electric lighting, a rheostat was used in the field of shunt machines, but this system is not a success on modern machines.

In order to vary the voltage quickly the rheostat arm would have to move a considerable distance instantly and regulators of this type have failed to control the voltage as the service demanded. Nor does the compound-wound generator give proper voltage when its speed is changed, and the compound winding does not correct for temperature effects.

Mr. Wirt then proceeded to describe a generator regulator recently invented by Mr. A. A. Tyrrell. Two types have been designed, one of them to be used with direct-current generators and the other for alternating-current generators. These regulators control the voltage of the generators by closing and opening a short circuit around the field rheostat, thus cutting in and out resistance in the field circuit of the generator, the voltage being varied by the length of time the resistance is included in circuit and out of circuit. This operation is made at a high rate of speed, varying from 50 to 800 times per minute. The movement of the contacts which switches in and out the resistance is accomplished by a relay, the motion of the contacts being about 1-16 of an inch.

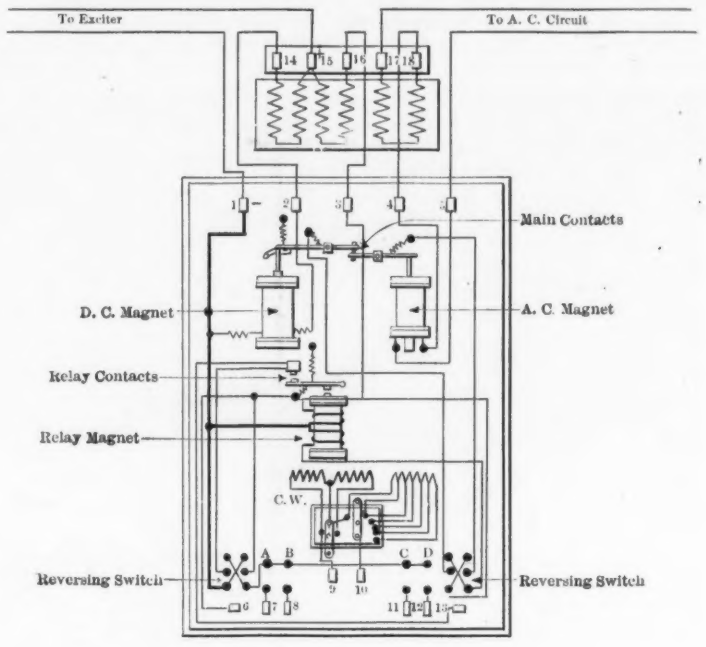
Fig. 1 shows the connections of the direct-current regulator. The magnet on the left is the control magnet, which is connected across the circuit, the voltage of which is to be regulated. A relay is located at the middle of the board. The movement of the contacts of the control magnet causes the relay contacts to open and close. The relay contacts are connected to the terminals of the field rheostat of the generator. When the relay contacts are closed the field rheostat is short-circuited, which cuts out the resistance and so causes the generator to give its highest voltage. When the relay contacts are open, all the resistance of the field rheostat is inserted in the field circuit of the generator and so causes it to give the lowest voltage; thus by rapidly closing and opening the relay contacts the voltage of the generator is maintained at a constant value. This operation is done at about 800 times per minute. A condenser is connected to the relay contacts to prevent injuirous sparking. The control magnet is connected by means of pressure wires to the center of distribution. It is stated that a curve drawing voltmeter when connected to a circuit of which the voltage is controlled by one of these regulators, will show a record as straight as if ruled with a straight edge.

The regulator for alternating-current generators controls the voltage by varying the resistance in the field of the exciter. The regulator for the alternating-current generator is similar to the direct-current regulator with the addition of another magnet, which is connected across the exciter circuit. A magnet is connected across the exciter circuit and another magnet is connected across the circuit to be regulated. The alternating-control magnet has two windings, one of which is connected across the circuit to be regulated, and the other is connected to a series transformer. The function of the second winding is to build up the generator voltage in direct proportion to the current in the line and thus compensate for the loss in the line. The compounding effect can be varied by means of two levers swinging over contact points, which cut in or out various turns on the magnet. Once the regulator is adjusted, it will maintain constant potential at a center of distribution without any hand adjustment irrespective of the character of the load. The regulation is not affected by speed changes unless the speed is so low that the voltage could not possibly be maintained. The alternating and direct-current control magnets together operate a pair of contacts known as floating contacts which operate a relay magnet which opens or closes the shunt circuit across the exciter field rheostat as in the direct-current regulator described above. The function of the floating contacts is so to actuate the relay magnet that the voltage is maintained under all conditions of exciter and alternator voltages. These contacts bring together the alternate and direct-current portion of the regulator and control the voltage of both simultaneously. The contacts will usually raise from no load to full load about 3/32 of an inch, while the exciter voltage may vary from 10 to 130 volts in order to maintain the desired alternating voltage.

One regulator will regulate any number of generators of any kilowatt capacity providing they are all running in parallel and the exciters are also in parallel.

The voltage regulators described above are designed to control the voltage of the generators. These regulators may be controlled by pressure wires brought back from a center of distribution, but as the distribution system from a central station is usually laid out for several centers, it is necessary to have means of automatically adjusting the voltage for additional centers of distribution.

For this purpose an automatic feeder regulator for alternating-current generators has been developed. It is usually customary to allow considerable drop in pressure from the central station generator to the incandescent lamp or other translating device. Frequently this drop amounts to 10 per cent. of the initial voltage. With such a drop, which varies according to the load, it is manifestly necessary to adjust frequently the voltage at the central station in order to



VOLTAGE REGULATION.

keep it at a uniform voltage at the center of distribution. At the present time this is generally accomplished by means of hand regulators and therefore it is only imperfectly done. An automatic feeder regulator will do the work much more accurately and more cheaply than an operator with a hand rheostat.

The alternating-current feeder regulators have been made in two types, one a booster transformer or the induction type, which is similar to the well-known constant transformer used with series arc lamps, the movement of the coils being accomplished by compressed air operating on a piston and cylinder, the movement of the coil being controlled by a voltmeter. This type of regulator has the advantage of having no contacts, and the voltage can be very gradually varied.

Where a transformer is used in connection with a transmission plant stepping down the voltage from, say, 10,000 to 2,000, a dial switch can be placed upon the transformer. The contacts can be arranged so that a portion of the winding can be cut out; thus the secondary voltage can be varied at will. The movement of the switch arm is controlled by a voltmeter, a motor furnishing the power necessary to move the switch. The voltmeter operates magnetic clutches which apply the power to the switch. The advantage of this type of regulator over the induction type is somewhat lower first cost. The disadvantage is that the voltage has to be varied by different steps depending upon the number of contacts employed. Usually a difference between steps of one volt is used and unless a large number of contacts are provided, which would make the apparatus probably too expensive. A variation of a volt is a little

too great for the best work, therefore the induction type regulator has advantages over the dial switch type.

Regulators of the above types have been used in connection with water power transmission plants, as in such cases the drop of pressure in lines is frequently very great and the variation in voltage considerable. There seems to be a large field for the use of such regulators. In some water power transmission plants the variation in voltage at times has been as much as 20 per cent., which gives very unsatisfactory service to the consumers. An installation of these automatic feeder regulators has corrected the trouble and maintained almost constant voltage, so that the service is satisfactory.

Heretofore in trying to overcome troubles from bad voltage regulation attention has been given almost wholly to the question of making water wheels operate within proper speed limits, but such means cannot be made to compensate for line losses, so that it would seem desirable to use automatic feeder regulators rather than to depend wholly on water wheel governors.

At the present time it is almost the universal practice to use separate circuits for lighting and motor work, necessitating large expenditure on the part of the central station management. It has been considered almost impossible to give good lighting service and have an extensive motor service operated from the same mains. With automatic voltage generator regulators and automatic feeder regulators, very satisfactory service can be obtained where lights and motors are operated from the same circuit and several installations have been made where these results have been obtained. This new practice will undoubtedly reduce the cost of outside construction by reducing the number of feeders.

Work of the Carnegie Institution.

The current issue of *Science* contains an official account of the organization of the Carnegie Institution and of its plans to date. Eighteen advisory committees have been appointed, those for engineering and physics being as follows:

Engineering—R. H. Thurston, Director of Sibley College, Cornell University, Ithaca, N. Y., chairman; William H. Burr, Professor of Civil Engineering, Columbia University, New York, N. Y.; George Gibbs, Consulting Engineer, Baldwin Locomotive Works, Philadelphia, Pa.; George S. Morison, Civil Engineer, 49 Wall Street, New York, N. Y.; Charles P. Steinmetz, Electrician, General Electric Company, Schenectady, N. Y.

Physics—R. S. Woodward, Dean of School of Pure Science and Professor of Mechanics and Mathematical Physics, Columbia University, New York, N. Y., chairman; Carl Barus, Professor of Physics, Brown University, Providence, R. I.; A. A. Michelson, Head Professor of Physics, University of Chicago, Chicago, Ill.

After quoting the trust deed, the report says that it is the judgment of the executive committee that the aims enumerated can be best carried into effect under the following principles, which are to be departed from only in very exceptional cases.

The Institution proposes to undertake,

(*A*) To promote original research by systematically sustaining,

(*a*) Projects of broad scope that may lead to the discovery and utilization of new forces for the benefit of man, pursuing each with the greatest possible thoroughness.

(*b*) Projects of minor scope that may fill in gaps in knowledge of particular things or restricted fields of research.

(*c*) Administration of a definite or stated research under a single direction by competent individuals.

(*d*) Appointment of research assistants.

(*B*) To increase facilities for higher education by promoting,

(*a*) Original research in universities and institutions of learning by such means as may be practicable and advisable.

(*b*) The use by advanced students of the opportunities offered for special study and research by the Government Bureaus in Washington.

The Institution does not propose to undertake,

(*a*) To do anything that is being well done by other agencies.

(*b*) To do that which can be better done by other agencies.

(*c*) To enter the field of existing organizations that are properly equipped or are likely to be so equipped.

(*d*) To give aid to individuals or other organizations in order to relieve them of financial responsibilities which they are able to carry, or in order that they may divert funds to other purposes.

(*e*) To enter the field of applied science except in unusual cases.

(*f*) To purchase land or erect buildings for any organization.

(*g*) To aid institutions when it is practicable to accomplish the same result by aiding individuals who may or may not be connected with institutions.

(*h*) To provide for a general or liberal course of education.

The executive committee, keenly realizing the importance of thoroughly investigating and fully considering every proposed action before recommending it to the trustees, have given much time and thought to the subject of organization, and at the several meetings have discussed the suggestions received from individuals and from the advisory committees. It is hoped and expected that the Institution will set a high standard for research. This the committee believes can be best attained and maintained by establishing such laboratories and facilities, not found elsewhere, as are necessary when dealing with problems.

The committee is of the opinion that organization in Washington should be provided for by:

(*a*) Purchasing in the northwestern suburb of the city a tract of ground suitable for present and future needs.

(*b*) Erecting thereon a central administration building, to serve as the administrative headquarters of research work conducted, directed, or aided by the Carnegie Institution.

(*c*) Establishing such laboratories from time to time as may be deemed advisable.

(*d*) Employing the best qualified men that can be secured for carrying on such research work as it may be decided to undertake in Washington.

(*e*) Continuing and developing the present office organization as the Executive Committee may find it necessary to do in order to properly conduct the work of the Institution.

The only organization outside of Washington to be provided for at present should be such advisers and advisory committees as may from time to time be found necessary in connection with the development of the research work of the Institution. It is the opinion of the committee that such persons and committees should be largely advisory and not executive in their function. Executive work should be in charge of paid employees of the Institution. These may be officers, research associates and special employees.

Soon after the Executive Committee began its investigations it became evident that two lines of policy were open, namely:

(*a*) To sustain broad researches and extended explorations that will greatly add to knowledge.

(*b*) To make small grants.

Research may be defined as original investigation in any field, whether in science, literature or art. Its limits coincide with the limits of the knowable. In the field of research the function of the Institution should be organization, the substitution of organized for unorganized effort wherever such combination of effort promises the best results; and the prevention, as far as possible, of needless duplication of work. Hitherto, with few exceptions, research has been a matter of individual enterprise, each worker taking up the special problem which chance or taste led him to and treating it in his own way. No investigator, working single-handed, can at present approach the largest problems in the broadest way thoroughly and systematically.

With an income large enough to enter upon some large projects and a number of minor ones, it appears to be wiser, at the beginning, to make a number of small grants and to thoroughly prepare to take up some of the larger projects. With this in view the Executive Committee recommended to the trustees that there be placed at its disposal for the fiscal year 1902-3, two hundred thousand dollars for aid to special researches in various branches of science, and $40,000 for the publication of the results achieved. During the year plans will be perfected, data secured and experience gained that will be of great service in formulating recommendations for the ensuing year.

In the opinion of the committee, the most effective way to discover and develop the exceptional man is to put promising men upon research work under proper guidance and supervision. Those who do not fulfil their promise will soon drop out, and by the survival of the fittest the exceptionally capable man will appear and be given opportunity to accomplish the best that is in him. When the genius

is discovered, provide him with the best equipment that can be obtained.

In making grants the wisest policy appears to be to make them to individuals for a specific purpose rather than to institutions for general purposes.

Under the authority conferred upon it by the trustees at their first meeting, the Executive Committee made three grants, as follows:

March 25, 1902. To the Marine Biological Laboratory, Woods Hole, Mass., for general support	$4,000
April 15, 1902. To Dr. J. McK. Cattell, Columbia University, New York, for preparing a list of the scientific men of the United States	1,000
April 15, 1902. To Dr. Hideyo Noguchi and Professor Simon Flexner, Philadelphia, Pa., for continuation of their studies of the toxicological actions of snake venom and allied poisons	1,000
Total	$6,000

Since the second meeting of the trustees, on November 25, 1902, the Executive Committee has made the following grants in the several departments of science mentioned. Anthropology, mathematics and other branches will be acted upon later:

Astronomy	$21,000
Bibliography	15,000
Botany	11,700
Chemistry	3,000
Economics	15,000
Engineering	4,500
Exploration	5,000
Geology	12,000
Geophysics	8,500
History	5,000
Investigation of project for southern and solar observatory	5,000
Investigation of project for physical and geophysical laboratories	5,000
Investigation of natural history projects	5,000
Marine biological research	12,500
Paleontology	1,900
Physics	4,000
Physiology	5,000
Psychology	1,600
Publications	5,500
Research assistants	25,000
Student research work in Washington	10,000
Zoology	4,000
Total	$185,200

As a convenient summary of the plans and methods thus far agreed upon the following minute was approved:

The methods of administration of the Carnegie Institution thus far developed are general rather than specific.

The encouragement of any branch of science comes within the possible scope of this foundation, but as the fund, munificent as it is, is inadequate to meet the requests for aid already presented, not to mention others which are foreseen though not yet formulated, attention has been concentrated upon a selection of those objects which, at this time and in our country, seem to require immediate assistance.

Efforts have been and will be made to secure co-operation with other agencies established for the advancement of knowledge, while care will be exercised to refrain from interference or rivalry with them. Accordingly, ground already occupied will be avoided. For example, if medical research is provided for by other agencies, as it appears to be, the Carnegie Institution will not enter that field. Systematic education, abundantly provided for in this country by universities, colleges, professional schools, and schools of technology, will not be undertaken. Nor will the assistance of meritorious students in the early stages of their studies come within the scope of this foundation. Sites or buildings for other institutions will not be provided.

Specific grants have been and will be made, for definite purposes, to individual investigators, young or old, of marked ability, and for assistance, books, instruments, apparatus and materials. It is understood that such purchases are the property of the Carnegie Institution and subject to its control. The persons thus aided will be expected to report upon the methods followed and the results obtained. In the publication of results it is expected that the writer will say that he was aided by the Carnegie Institution of Washington, unless it be requested that this fact be not made known.

In order to carry out the founder's instructions in respect to bringing to Washington highly qualified persons who wish to profit by the opportunities for observation and research afforded by the various scientific bureaus of the United States Government, a certain sum is set apart for this purpose.

In addition, the Carnegie Institution will appoint from time to time a number of persons to be known as research assistants, who may or may not reside in Washington, and who shall undertake to carry on such special investigation as may be entrusted to them by the Institution. The appointments will be made for a year, and may be renewed in any case where it seems desirable. Permission may be given to go abroad, if special advantages not accessible in this country can thus be secured.

Publication is regarded by the founder as of special importance. Accordingly, appropriations will be made for this purpose, especially for the printing of papers of acknowledged importance, so abstruse, so extended or so costly that without the aid of this fund they may not see the light.

With respect to certain large undertakings involving much expense, which have been or may be suggested, careful preliminary inquiries have been and will be made.

In order to secure the counsel of experts in various departments of knowledge, special advisers have been and will be invited from time to time for consultation. Valuable suggestions and counsel have already been received from such advisers.

George Westinghouse in London.

At Claridge's Hotel in London, one night last month, Mr. George Westinghouse entertained at dinner a large company of British railway managers, financiers and scientists. Two speeches were made of unique interest. One of these was by Lord Kelvin, the other by the host of the occasion.

Lord Kelvin said: "At this dinner of friends I would like to express a common sentiment which all must feel, our appreciation of the qualities of our charming and beloved host, Mr. Westinghouse. I am sure that Mr. Westinghouse's coming to England reminds us all of the advantages that England has derived from his genius and perseverance and grand skill in bringing out for the public good so many of the results of science and inventiveness. There are many railway men present at this table, and many passengers by railways—which means that every inhabitant of our country is represented here. When people belonging to these two classes—the railway men and the traveling public of Great Britain are gathered together as now, we can scarcely see Mr. Westinghouse without feeling how much we owe to him for the Westinghouse brake. (Applause.) But Mr. Westinghouse has not stopped with his brake; he has gone on and on and on, in America, flashing over again on this side of the Atlantic, and bringing his energies here. The present development of the electric industry in the United Kingdom owes its growth largely to him. 'Largely' is a small word to express how much we owe to him. I do not wish to enter into any comparisons or superlatives, but I do not think any man in the world of engineering could be named to whom more is due than to Mr. Westinghouse for his work in electric engineering.

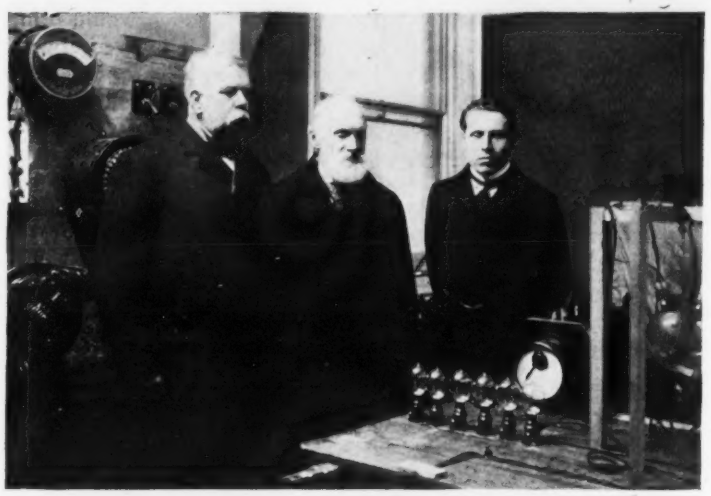
"Other things besides mechanical engineering and electrical engineering we owe to Mr. Westinghouse. We owe to him the bringing to England and causing to be appreciated in England, American methods—American methods in a certain way, which I may refer to without invidious comparison; American methods of industry, and resolution and determination—which are also English methods, because they have been inherited from England. (Applause.) Here it comes back to us, with compound interest, in the shape of Mr. Westinghouse, and I am sure that we all feel that we are largely indebted to him for what he has done for us, what he is doing for us, and in advance, for what he is planning to do for us in the future. We appreciate all this, and we appreciate him as a kind friend, a genial host and entertainer. I ask you to join me in drinking the health of Mr. George Westinghouse."

The toast having been honored with enthusiasm, Mr. Westinghouse rose to respond. He said: "I wish to thank our distinguished scientific friend, Lord Kelvin, for the complimentary language he has used about me. And I would like to say to all you railway men here present, that my life has been very much associated with your calling. I invented the brake, of which Lord Kelvin has spoken, when I was scarcely twenty-one years old, and thus became acquainted with railway men when the railway industry was rather a poor one compared with what it is to-day. Since then I have closely followed railway operations, becoming acquainted with almost

everything that is being done in them, and it is particularly my friendship with railway men which has prompted me to go forward in my work with an interest and keenness that probably would not have resulted from ordinary commercial motives.

"Lord Kelvin has been good enough to refer to my coming to this country. I came here thirty years ago, and for ten years or so I was here about half the time. At that time it was very difficult to get any new thing done in England. I often wanted to sit down and cry, because I could not get anyone to believe in anything. (Laughter.) I wanted in those early days to try an iron brake shoe, because, on account of rapid wear we couldn't keep the wooden one adjusted. I had to beg and beg to be permitted to put a set of metal brake shoes on one tender on the Caledonian Railway. Finally I succeeded. You all know that nowadays all the railway shoes or blocks are made of cast iron or other metal and are used upon all the wheels of the train.

"Lord Kelvin has alluded to 'American methods.' May I say that one of your English difficulties is inherent, I think, in an old-world, highly-developed country. After a man (or a nation) has worked prosperously for a long time, he opposes improvement or suggestion, thinking, 'What I have is good enough—I won't try a new thing.' In America, however, the necessities have produced different results. Lord Kelvin speaks of England having sent many men to America. It has also sent to us many ideas. If you take up the American patent records and follow the cases in litigation especially you will find that among the references cited many



Mr. George Westinghouse. Lord Kelvin. Mr. Chas. Merz.

WATCHING A TEST OF HEWITT CONVERTER.

(Taken by Light of a Hewitt Mercury Vapor Tube.)

are of English origin, some of them containing ideas so complete, the wonder is that the inventions disclosed were not established fully and completely in your own land. These records seem to show that Americans and Englishmen have invented the same thing many times.

"In America, however, we have always been short-handed with regard to labor. We have been obliged to find methods whereby one man may accomplish the work of two or three men as compared with your practice here. We have had the best men from Europe—Englishmen, Germans, French, everybody—skilled men, highly trained men, as well as laboring men; we have combined their experience with our own, coupled it with our necessities, and have thus accomplished results unattainable in a country like this, where you have more labor than you can well keep employed.

"As an illustration of what has been accomplished by the use of electricity in a great industry, I may cite the Homestead Mills of the Carnegie Company. Mr. Schwab, whose name is well known to you, is a genius in his way, particularly in the management of men; he is a master in organizing and directing men. Mr. Carnegie believed in him, and if Mr. Schwab made a suggestion in regard to the use of new appliances, even if it involved the tearing down of an old mill and putting up a new one, the new one was ordered. What Mr. Schwab thought should be done was done. As a result of such progressiveness we may see the splendid mills at Homestead, where they produce with about 4,000 men three times as much steel as the Krupp works produce with 15,000 men. The results are simply wonderful. You can start there to-day, in a building containing steel-melting furnaces, and you will there see three men mounted on a car with the charging apparatus which is moved and operated by electricity. With a few movements of this ingenious contrivance three men charge twenty furnaces, which, prior to the use of electricity, would have required the labor of over 200 men.

"You may go into the yards of the Homestead mills where they pile the metal in stock. This yard is covered by a system of overhead cranes, and the result is that not only here, but in the mill, and in every other place, you may see great weights lifted and many undertakings going on without a single man exerting himself a bit—working not half as hard as I am working now. (Laughter.)

"I took some English friends to Homestead. Mr. Schwab, after guiding us through several departments, said: 'I will now show you where we turn out 750 tons of plate girders per day.' The mill was in the shape of an L. We went into the short end of the L, where the furnaces were fed by natural gas, of course requiring no stokers. The end at which we entered had a rather low roof, and there was in sight a contrivance like a battering ram in front of the furnaces; two workmen were sitting down eating their dinners near by; no one else was present. I thought: 'Mr. Schwab has made a mistake; he has asked us to see a mill that is not in operation.' But we went through this mill, which was about 200 feet long, and suddenly we heard a rattle and then saw a truck approaching loaded with a big ingot. No one touched the truck or the ingot. The load came to a platform, the crane overhead dropped a pair of tongs and quickly put the ingot on the roller table, and as it moved along to the great rolls, it was automatically kept in place. The adjusting screws of the rolls were turned by little electric motors, and not a man in that house did a bit of work. It was just as easy as what you are doing now—looking on! (Laughter.) We went back to the furnaces. There was a fifteen-year-old boy seated in a little place called the 'pulpit.' He was able, merely by the movement of levers, to open at will any of the furnace doors, and move the car along. And we saw this car come in front of a furnace and the charging machine approach and take out of the open furnace a hot ingot, which was dropped on the car and moved off to its work. There was this boy doing absolutely no hard work, and his mill was turning out 750 tons of steel plate each day. My English friends said: 'England has no chance in competition with such methods.'

"Now, all this sort of thing came about in America because of our necessities. We hadn't men enough to do our work. There was a premium in favor of those who could invent machines to work and thus supply the deficiency.

"At the Carnegie mills we went to see three blast furnaces. They were making 1,800 tons of pig-iron in twenty-four hours. We saw only two or three men on a truck, which was moved automatically. These men were letting the ore run from shoots and mixing it in the required quantity, and when they had filled a truck, it was carried up and its contents dumped into a furnace whence it returned for another load. They were running the metal into an immense receptacle into which the metal from all three furnaces was mixed. From this place the metal was taken as required, put into a special tank, mounted on a car and taken to Homestead, two or three miles away, to be poured into the furnaces; one heating only was required.

"I refer to all this simply to illustrate the immense advantages we have had in America, and the kind of experience I have been able to bring to this country, and to which Lord Kelvin so generously alluded, and which I hope will be not only useful and profitable, but will establish for the company I represent a name and a position which you will all regard as most satisfactory. (Applause.)

"I want to thank you very sincerely for the kind expressions with which you have greeted me, and especially for your acceptance of my invitation to inspect this evening a couple of inventions, one of which—the Hewitt mercury vapor lamp—is a complete and accomplished thing. The rays of this light are not very pleasant as yet, but the light is likely, however, to be of great value. The other invention—the Hewitt static converter—is quite new, and its object is to convert alternating currents into direct current at so low a cost in comparison with the sums which have heretofore been expended for equivalent results, that it is likely, when fully perfected, to cause an immense stimulus in regard to the use of electricity in all parts of England, and particularly in the agricultural

parts of the country, for farm work, and for moving all kinds of vehicles.

"I have taken advantage of these inventions to invite you to see them as my guests, and I thank you for having honored me with your presence to-night."

Wireless Telegraphy Lecture Apparatus.

We illustrate herewith the apparatus used by Mr. A. Frederick Collins in his lectures on wireless telegraphy. During the present season Mr. Collins has delivered about twenty lectures, including one before the New York Electrical Society and one before the Brooklyn Institute of Arts and Sciences.

The receiver (Fig. 1), which was presented to Mr. Collins by

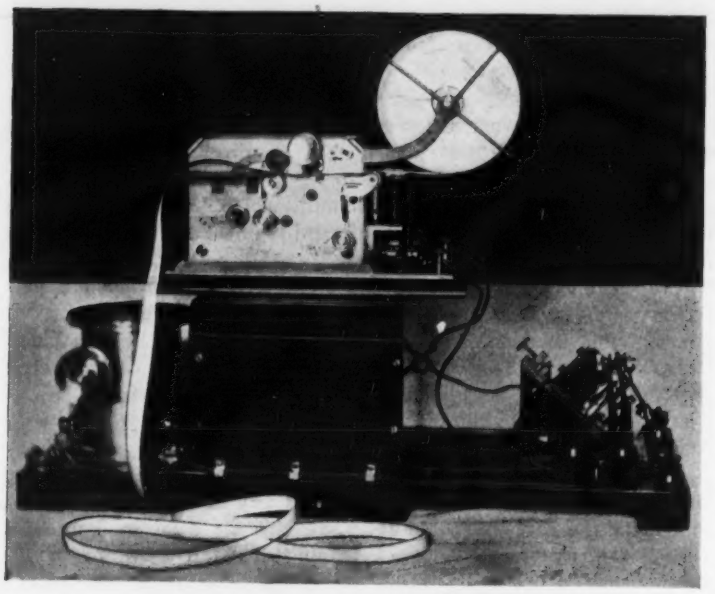


FIG. 1.—WIRELESS TELEGRAPH RECEIVER.

the Marconi Wireless Telegraph Company of America, is of the same type as that regularly employed by Mr. Marconi for his long-distance tests. The relay is so sensitive that by closing the circuit through the medium of the body it will respond, whilst the sensitiveness of the coherer is so great that for experimental demonstrations the slightest sparks of a direct current is more than sufficient

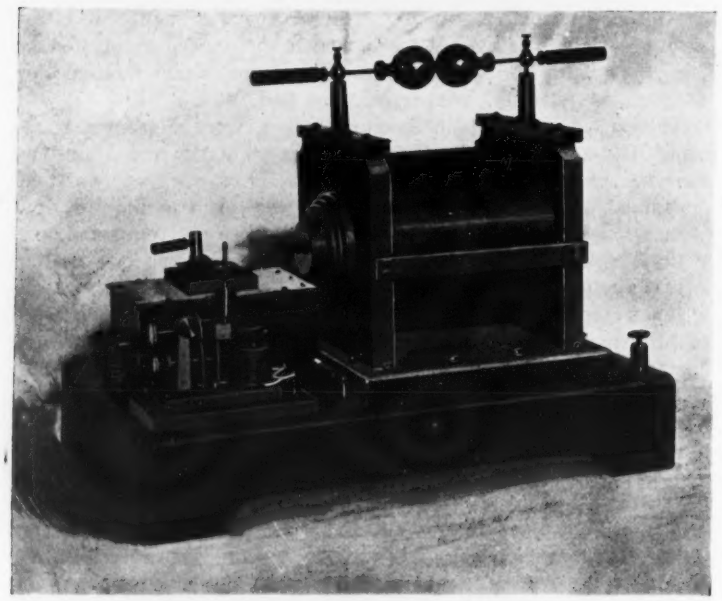


FIG. 2.—WIRELESS TELEGRAPH TRANSMITTER.

to operate it, and the antennæ and artificial earths must be cut out entirely to avoid jamming.

The coil shown in Fig. 2 has all the latest improvements, including an interlocking switch, an adjustable condenser and an independent vibrator.

The complete equipment is capable of sending and receiving messages a distance of fifty miles in actual practice, whilst the receiver in connection with a transmitter of greater power will respond to a correspondingly greater distance.

Points in the New German Tariff.

Mr. Frank H. Mason, the energetic and efficient U. S. Consul-General at Berlin, has forwarded the State Department an interesting digest of the new German tariff act, in regard to which he says: The tariff act which, after the longest and most momentous struggle in German legislative annals, passed the Reichstag during an all-night session on December 13-14, was immediately thereafter confirmed by the Bundesrath and became a law of the Empire. The imperial decree followed, announcing its enactment, defining the classes of articles that are to be duty free, and declaring that the date at which the new tariff law would become operative will be announced hereafter. When this will be will depend mainly upon the time that will be necessarily occupied in negotiating new commercial treaties with the several nations with which Germany has had such treaties during the past ten years, which conventions must now be revised and agreed to on the wholly novel basis which will be established by the new tariff. How long this will require is as yet a matter of conjecture, but it is generally thought that the treaty negotiations will occupy from twelve to eighteen months, which would bring the tariff law of December, 1902, into force somewhere between January and July, 1904. The law as finally enacted was, with a few more or less important changes, practically identical with the bill originally proposed by the Imperial Government and first officially published on July 26, 1901. It is essentially of "agrarian" character, i. e., the agricultural classes or interests are favored with duties highly protective of the products of the farm and field.

Subjoined is data in regard to electrical and allied apparatus that is affected:

	Marks.	
Electrical machinery, viz., dynamos, electric motors, converters, transformers, etc., for machines:		
Under 500 kilograms (1,102 pounds).....per 100 kilograms	9.00=	$2.14
500 to 3,000 kilograms (1,102 to 6,614 pounds) .....do..	7.00=	1.66
More than 3,000 kilograms (6,614 pounds) in weight.....do..	6.00=	1.42
Machine tools for working metals, wood, or stone, steam and hydraulic presses, welding machines, mechanical hammers:		
250 kilograms (551 pounds) in weight.....per 100 kilograms	20.00=	4.76
250 to 1,000 kilograms (551 to 2,205 pounds) .....do..	12.00=	2.85
1,000 to 3,000 kilograms (2,205 to 6,614 pounds) .....do..	8.00=	1.90
3,000 to 10,000 kilograms (6,614 to 22,046 pounds)....do..	6.00=	1.42
Over 10,000 kilograms (22,046 pounds).....do..	4.00=	.97

Steam engines, turbines, gas and caloric engines, blowing machinery, pumps, portable cranes, pile drivers and power hammers, ice machinery, etc., range from a rate of $23.80 per 100 kilograms (220.4 pounds) for machines weighing less than 40 kilograms (88 pounds) each to $4.28 for machines between one and two tons in weight, and so on down to 83 cents per 100 kilograms for machinery weighing more than 100 tons each. Under the same interpretation, the following items appear, but not very clearly:

	Marks.	
Telegraphic instruments, telephones, electrical lighting and power transmission apparatus, electrical measuring instruments, etc..	60.00=	$14.28
Motor, railway, and street cars	10.00=	2.38
Freight cars, open and covered	5.00=	1.19
Passenger cars:		
Not upholstered	7.50=	1.78
Upholstered	12.00=	2.85

Under the new tariff most raw materials, including copper, lead and aluminum, remain free of duty.

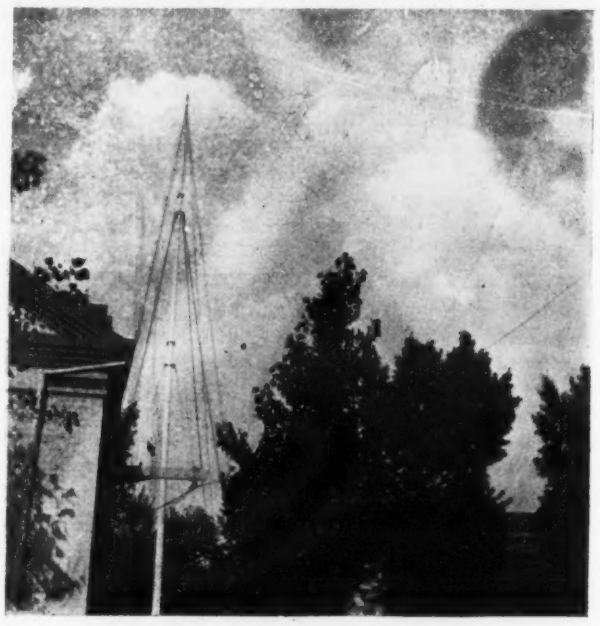
The general subject now enters upon its final and, in some respects, most complicated phase—that of the negotiation of a new set of commercial treaties based on the revised tariff. During the final debate on the bill of the Reichstag, it was promised that the Government would undertake, before making new conventions, a thorough revision of all existing treaties which contain the most-favored-nation clause. As a reason for this, it was stated that the United States has introduced in practice a modified interpretation of that clause which renders it inadvisable for Germany to concede most-favored-nation privileges to any countries except those with whom new and special arrangements will be made.

United States Navy Tests of Wireless Telegraphy.

Official tests by the United States Naval Board of Wireless Telegraph examiners of the De Forest system between the Naval Academy, Annapolis, and the Washington Navy Yard, were recently concluded.

These two stations are separated by thirty-six miles entirely overland, consisting of rough, hilly country heavily wooded. German and French wireless telegraph engineers who have essayed to cover this distance have pronounced it equal to 180 or 200 miles over salt water. The Slaby-Arco and Braun German systems and the Ducretet and Rochefort systems from France have all been tried over this range. Though exhaustive experiments were made, the Slaby-Arco system was, it is said, the only foreign system which was able to transmit intelligible messages, and this only after careful tuning of the two sets of instruments. The De Forest apparatus was in use by the Naval Board three weeks, and no difficulty whatever was experienced in covering the distance from the start. No tuning whatever was required. This results from the extreme sensitiveness of the De Forest receiver and the positive and powerful action of the transmitter employed.

The De Forest anti-coherer, being a current-operated device, is best placed at a current loop or static node, that is, at the base of the antenna, which, it is said, accounts for its operating where the coherer, or potential-operative device, is uninfluenced. Inasmuch as the attaching of an earth connection to one side of the receiver compels a static node there, it was found that signals continued to



U. S. NAVAL WIRELESS TELEGRAPH STATION.

be received, even when a length of wire, inductive or non-inductive, was inserted between it and the base of the antenna, even when this length amounted to that of the antenna, or more.

At Annapolis and Washington the Navy Department has masts 180 feet in height. From these hung a fan of five wires, of an average length of 200 feet. The ground connections consisted of two copper plates, 2 x 6 feet each, buried 6 feet below the surface. During the tests an officially recorded speed of 35 words the minute was maintained, and many of the test dispatches were in the Navy Code. Press dispatches were continually exchanged, and the value of "wireless" as a news transmitting medium was interestingly demonstrated when, after the runaway accident to Secretary of the Navy, Moody, at Annapolis, the De Forest operators at Washington had the news to the press and the Navy Department full thirty minutes before it was known by telephone or telegraph.

As a result of the tests the Navy Department has placed a contract for twelve sets with the American De Forest Wireless Telegraph Company. Sea tests of the system will be undertaken in March, upon the arrival of the cruiser *Prairie* from the Caribbean. The De Forest Company is now erecting at Cape Hatteras a 175-foot tower and a 5-hp outfit for communicating with vessels, and with Block Island, 300 miles distant. At the latter point a similar plant is under construction by the *Providence Journal* for commercial purposes. Other stations are now under way by the De Forest Company in Porto Rico. Orders have been placed by the De Forest Company, representing a total of 180 kw for four stations for trans-Pacific communication, to be located in Lower California, Hawaii, Philippines and China; and during the recent naval tests Dr. De Forest sent the following dispatch from Annapolis to President Roosevelt: "I have the honor to send you the first greetings by an American wireless telegraph system from Annapolis Naval Academy to Washington, with the conviction that within eighteen months we shall do the same from Manila, via Hawaii to California."

Sound Condition of General Electric Finances.

What seems to be a very close forecast of the General Electric annual figures, or what is at least an excellent analysis of the company's condition appears through financial channels, and is well worthy of note.

An indication of the growth of the company's business may be found in the following statement of sales and orders:

	Amounts billed.	Orders rec'd.
1898	$12,396,093	$14,382,342
1899	15,679,430	17,431,327
1900	22,379,463	26,323,626
1901	28,783,275	27,969,541
1902	32,338,036	34,350,840

As compared with five years ago, therefore, the company's business has risen $20,000,000 a year. It is worth noting, moreover, that on a similar basis of accounting, the amounts billed in 1902 would have been over $34,000,000, or almost $22,000,000 more than in 1898.

Excluding strictly capital items, assets and liabilities compare as follows as of January 31, 1897, and January 31, 1902:

Assets:	1897.	1902.
Stocks and bonds	$8,545,795	$9,825,120
Cash	703,483	4,058,448
Receivables	4,578,600	11,364,345
Work in progress	517,866	1,338,258
Inventories	4,034,753	8,876,883
Total current assets	$18,380,497	$35,463,055
Less various liabilities	468,931	1,357,211
Net working capital	$17,911,566	$34,105,844

In the five years there has been, therefore, a net gain of over $16,000,000 in the working capital. Every dollar of this has come from earnings, as nothing has been raised by the sale of capital stock or bonds. The working capital test is regarded as extremely satisfactory in the case of General Electric.

It is further to be noted that on January 31, 1902, the company's plants, patents, etc., were carried in its balance sheet at a total valuation of $6,000,000. In addition it had real estate amounting to $464,195. On January 31, 1897, the company's patents, plants, franchises, etc., and real estate were carried at $12,043,018. Thus, in the five years, the company has written $6,000,000 off the value of its plants, patents etc., as they stand on the books. But, in addition to this, it has also written off all improvements, enlargements, etc., made during that time. These have amounted to the following sums:

1899	$1,167,179
1900	1,683,762
1901	2,531,838
1902	1,583,655
Total four years	$6,966,434

These amounts are in addition to the ordinary expenditures for repairs, renewals, replacements, and maintenance of all kinds.

The General Electric Company has now outstanding $42,031,600 of stock and about $2,000,000 of debentures issued for the purchase of Sprague Electric stocks. It is reckoned that the earnings for the year ended January 31 will be equal to at least 20 per cent. on the company's stock.

New York Electrical Society at the Edison Station.

The members of the New York Electrical Society mustered 250 strong at the 231st meeting of the society, held January 29, to inspect the magnificent new Waterside Station of the New York Edison Company. The arrangements for the disposal of the guests were so admirably made that each of the visitors, placed in charge of a special guide, was able to cover all the salient points of the station. The building, which covers the block between Thirty-eighth and Thirty-ninth Streets, First Avenue and East River, is approximately 272 ft. long by 197 ft. in width. The plant has been very fully illustrated and described in these pages. The boiler room on the north side of the building is 76 ft. wide, the operating room occupying the remainder of the building. The boilers, of which there are 56, are arranged in two tiers. They are of the B. & W. water tube type, rated at 650 hp. Each boiler contains 294 four-in. tubes, and has a heating surface of 6,500 sq. ft. The feed water passes first through primary heaters, of the induction type, located on the engines, which raises the temperature to about 120°, and thence it runs into storage tanks, into which also empty the drips from the live steam piping, engine re-heaters, etc. The feed pumps draw from this tank and force the water through the secondary heaters into the boilers.

The plans call for sixteen generating units in the operating room; eight of these are now installed complete. The engines were built by the Westinghouse Machine Company, and are of the three-cylinder, compound, marine type, having a nominal capacity of about 8,000 hp each. The fly wheel is 23 ft. in diameter and weighs 60 tons. The three cranks are set at angles of 101°, 133° and 126° in order to give as near uniform angular velocity as is possible. Each engine is provided with an individual surface condenser, containing 9,200 sq. ft. of cooling surface. The air and circulating pumps are operated by a 16 x 24 Corliss steam cylinder with positively driven valves, the speed being controlled by a throttle governor. The eight generators already installed are of General Electric make, 3-phase, 25-cycle, 40-pole, 6,600 volts, and have a capacity of 3,500 kw, normal or will carry 4,700 kw for three hours. The revolving field has a diameter of 16 ft. 8 in. and weighs 13,000 pounds. The armature is built up of laminated steel, the coils being secured in the slots by dove-tailed wedges. There are 240 slots, that is, 2 per phase per pole. The field current is supplied by three motor generator sets. The motors are 225 hp, 6,600 volts, of the induction type, with squirrel-cage armatures and are directly connected to 150-kw, 150-volt, direct-current generators, the unit running at 500 r.p.m. In addition to these exciters, a storage battery capable of supplying current to the fields of sixteen generators for one hour is always connected to the field-charging bus. The energy required by the field of each generator at normal load is about 120 amperes at 175 volts.

The three main cables (500,000 cm) from each generator, together with the field cables and controlling wire cables, are run on brackets in the run-way to the basement of the switch galleries; from there they run up through individual ducts to the main generator switches, and from thence through the selector switches to the two buses. All switches are of the oil break compartment type operated by electric motors. The switches controlling these motors and all other instruments and apparatus used in connection with the generators, are mounted on the pedestals and panels on the third gallery. As each generator has a separate pedestal, it minimizes the chances of errors. Directly back of the generator pedestals are the panels containing the controlling switches and instruments for the feeders, of which there will be 40. Twenty-six of these are now installed. Each feeder has two oil switches in series, one of which is controlled by an automatic overload and time-limit relay. These switches are located in the lower galleries. There are two sets of high-tension bus-bars, to either of which any generator or any feeder can be connected. These are located in the bus chamber back of operating gallery.

At the close of the inspection, superintended by Messrs. John Lieb and Arthur Williams, a supper was given to the members of the society, and a vote of thanks was tendered to the company for its courtesy and hospitality. The evening was one of great enjoyment and success.

Telephony in Brazil.

The Brazilian Government has authorized the construction of a telephone line between Rio Janeiro and Santos.

A Lecture on Business Automobiles.

An extremely able and forcible lecture was delivered at the Automobile Club of America on Tuesday, January 27, by Mr. Hayden Eames, of the Westinghouse automobile department, on progress in the introduction of business automobiles. Mr. Eames has been in closest contact with the art for several years past and his utterances have an authority of no slight weight. The electric vehicle was considered almost exclusively and the statement was made that almost the only obstacle to the progress of the electric business vehicle is that many business men will not subject a motor vehicle to a test under the same conditions of operation as their horse-drawn vehicles work, but will insist upon impractical requirements regarding mileage, etc. It was stated that careful experiments by a leading firm of makers of electrical vehicles which were made in this city and vicinity showed the most difficult route in the entire city, which, as operated by a local express company, required three wagons and twenty-one horses, to be eleven miles in extent, extending from the Grand Central Station to a point in Brooklyn. This route could be covered by a single motor vehicle at much less expense, the annual saving being sufficient to pay for a charging plant at both ends.

Another interesting comparison was made from actual results of a year's trial of an electric vehicle for express work in Pittsburg, where the annual expense was $1,998, as against $3,469.40 for horse service, showing an annual difference of $1,471.40. This data has already been very fully discussed in our columns by Mr. Eames. Mr. Eames also said he knew of two cases where orders for 900 electric vehicles had been given, one for 700, and the other for 200, neither of which could be filled.

In moving a vote of thanks on behalf of the club, Mr. T. C. Martin expressed the conviction that the topic under consideration was one of the most important that automobilists could discuss. The bicycle had ceased altogether to be a luxury or a fad. It had shrunk to the proportions of necessity, and was more or less a beast of burden. To-day saw the boom of the "auto," but he believed that while there was a larger future for the pleasure automobile than for the bicycle, the boom and the profits would shrink; and then, in time, automobile builders would find their largest opportunity in business vehicles. Of this class he considered that the electric in cities had the brightest prospects, and as supplementing Mr. Eames' figures he pointed out that the cost of electric service was always and steadily diminishing. In fact, about the only two things in the last two years that were cheaper in New York City were electric current from the Edison mains and telephone service. As for gasoline, there was little reason to expect that to get cheaper; and he hardly thought steam was in the race at all.

To Develop Trolley Systems in Holland.

At a meeting of the Netherlands Tramways Corporation, recently organized under the laws of the State of Connecticut for the purpose of acquiring and building electric railways in Holland, the following directors were elected: Henry J. Pierce, W. Caryl Ely, Charles W. Goodyear and Pendennis White, of Buffalo; William B. Rankine, of Niagara Falls; G. L. Boissevain, F. S. Smithers, N. W. Halsey, J. G. White, and James M. Edwards, of New York, and M. J. Boissevain, of Amsterdam, Holland. Officers elected were: President, Henry J. Pierce; vice-president, G. L. Boissevain; secretary, W. Paxton Little; treasurer, Edwin Henderson.

The Netherlands Tramways Corporation, capital $3,500,000, has been formed to purchase street railroads and to build electric lines. It has purchased all the street railroads in the city of Haarlem, consisting of part horse and part electric lines, and will equip the former with electricity. It has also purchased a road running from Haarlem five and one-half miles to Zandwort, on the North Sea, the second largest Dutch seaside resort. Franchises have been obtained, through F. Anderheggen, Jr., and L. J. Neumeyer, of Amsterdam, and contracts let to J. G. White & Co. for the building of a double-track electric railroad to run from the center of the city of Amsterdam to Haarlem, a distance of twelve miles. This road, which will be known as the Electrische Spoorweg Maatschappy, will probably be completed early in 1904.

New Telephone Patents.

Two patents of the issue of January 20, of interest to the telephone field remain for consideration. These both relate to protective devices and with the two telephone patents of the Patent Office issue of January 27, form the basis of the present notice.

Of the protective devices, the first is described in a patent granted to T. E. Scantlin, of Lafayette, Ind. This protector is of the "sneak-current" type, which is to say that the mass of material in it is made so large that the time element becomes a considerable factor in determining the operation. In this protector, as was the case with a somewhat similar device noted in these columns a few weeks since, a high resistance medium, such as carbon, is inserted in the circuit so that any excessive current will evolve sufficient heat to melt a fusible cement normally holding the parts together. The essential novelty of the present device lies in the use of the high resistance material in granular form, the granules being either in a closed chamber having terminals soldered on with fusible metal, or held together in a

FIG. 1.—SCANTLIN THERMAL CUT-OUT.

block by cement having a low melting point. Fig. 1 shows sectional views of three designs for this arrester.

The second protective device is the invention of Mr. Joseph Sachs. This device is a combination safety fuse, "sneak-current" fuse, and lightning arrester, all disposed in and around a shell of fiber giving the general appearance of the regular enclosed fuse of to-day. Fig. 2 shows a sectional view of the arrester. At the right the fuse proper appears extending about two-thirds through the enclosing tube. In practice this portion of the tube receives the usual asbestos packing. At the left, a sliding terminal controlled by a spiral spring is arranged. Between these two units, a high-resistance carbon rod is placed. This carries metal terminals and is held in position by easily fusible solder. The main circuit passes from end terminal to end terminal, a "tell-tale" circuit being arranged as shown. The lightning arrester is formed about the outside of the tube by concentric-metallic rings, the one connected to line as shown, and the other to ground, these rings being separated by a perforated mica space ring.

Of the two patents of the January 27 issue, both are the work of German inventors. The first is called a line tapper and consists of a telescoping, hollow, metallic rod having a hook at the upper end and a self-winding reel at the lower end. Within the rod an insulated flexible conductor is placed, held taut by the

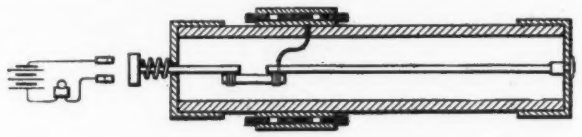


FIG. 2.—SACHS COMBINATION FUSE AND LIGHTNING ARRESTER.

tension of the spring in the reel, about which the conductor is wound. The flexible conductor carries a hook and by proper manipulation the hooks of this and that of the rod may be caught about the wires of a line which is to be tapped, that line thereby being extended to within convenient reach at the base of the rod. When the rod is closed, the reel winds up the slack and draws the hook of the flexible conductor into a socket. Christian Dietz, of Munich, is the inventor.

The second patent is granted to W. Höhne, and provides for a "speaking-tube" telephone system wherein the wiring is so arranged that if, after a call, any subscriber fails to bring his switching mechanism to the normal position, no interference with the service will result. This is accomplished by interposing a self restoring switch between the regular switching mechanism at each station and the telephone instruments, which switch at any station must be manually depressed during all conversations originated at that station. Thus, the labor of holding the switch falls upon the station making the call and not upon the one receiving it. It is hardly probable that such an arrangement will appeal to Americans, and if tried here it would be interesting to note how long it would be before ingenious users would hold the switch by pegs of wood or other "labor-saving" devices in a manner to defeat the especial object of the system.

Electric Power and Floods.

The conservation of forests and water supply is coming to attract more and more attention. In its first annual report the New York State Water Storage Commission says the damage resulting from floods in New York State during 1902 aggregated more than $3,000,000. The commission is of the opinion that most of the important streams can be regulated by storing their flood waters in reservoirs on the streams themselves or their tributaries at moderate cost. This work, it thinks, should be intrusted to a permanent commission, with power to assess upon beneficiaries costs of remedial work.

"The time has arrived in the State," the commission says, "when the continued denudation of forests has intensified freshet conditions, when electrical progress has rendered power in small units economically available long distances from interior sources of generation by water power, and when the sanitary requirements of increasing urban population, the demand for draining marshes and the increased development of internal water communication render mill acts in use in other States inadequate, and demand that we take an advanced position in this matter of river regulation."

At the St. Louis Exposition, the government officials will show a miniature irrigation system, and they have selected that of the San Antonio Company, of California, which carries on both power and irrigation work from the San Antonio River. The river has that characteristic of mountain torrents, a heavy fall, and it was necessary to conduct the water but a comparatively little distance in a ditch around the foothills to a point where it would have a drop of 700 feet to the power house. The volume of water is such that, estimating on the lowest flow of water ever known, the minimum of power to be developed is estimated at 400 hp, while the maximum is estimated at about 1,200 hp. Even the smaller amount is sufficient to pump all the wells, light the houses and streets of the colony and meet such demands for power as now exist.

The fact that the electric plant, as well as the irrigation system, is owned by the land owners of the colony gives to the entire system what is practically public ownership. It is the electric plant which differentiates the Ontario system from other irrigation systems of the West, and which has led the government officials to select it as a model which should be followed wherever it is practicable to work on the same lines.

Municipal Ownership at Hagerstown, Md.

We find the following gloomy view of the local municipal situation in the *Hagerstown Morning Herald:* "The deplorable condition of the city finances is a matter of extreme regret to every citizen and taxpayer. The municipal lighting plant shows a condition bordering on bankruptcy. It is difficult to imagine what has brought matters to such a pass when the recent statement of the Street Commissioners places the cost of street lighting at $56 per lamp. The balance of unpaid bills amounts to the startling sum of $3,900. The levy for street lighting was 9 cents on the $100, but at the time the levy was made Mayor Holzapfel insisted that it was insufficient to meet the needs, as a number of bills for the previous year were pigeon-holed and had to be paid out of this year's levy. He took the view that the street lights were costing considerably more than the commissioners contended. His statement placed their cost at $104 each. The trifle of taxes yet to be collected gives no hope of relief from this distressing condition and the taxpayers and property owners might just as well make up their minds to pay a decidedly higher tax rate next year. The deficit will have to be met and the rates placed sufficiently high to meet the current needs as well. As the increase will be entirely for electric lighting, the cost of the investment to the town will be no trifle. The city authorities have a grave problem to face, and it will tax their brains and ingenuity to cope with the situation. They will, it is hoped, confer and act wisely. They must find some method by which the city plant can be made less expensive, but, of course, with an eye to the well-being of the works and system, so that when the annual report is made conditions will be brighter and more encouraging."

Sale of Richmond, Va., Independent Telephone Company.

The property of the Richmond Telephone Company has been sold to Warner Moore & Co., who are said to be acting for the Bell Telephone Company. In its petition to the common council for permission to transfer its property to the Southern Bell Telephone Company, and to be released from its obligations to the city under its ordinance, the Richmond Company stated that it had ascertained that public opinion was emphatically in favor of only one telephone system, and that as it is now required to put its wires under ground, to continue its system at its present rates would entail upon it an increased loss. President Maupin, of the Richmond Company, said that the loss suffered by the proposed sale would amount to $60,000. Mr. Warner Moore, the principal holder of the company's stock and bonds, addressing the common council, said that every resource had been exhausted in the hope of interesting additional capital, but he did not think the company could be made to pay, and that the concern, notwithstanding the use of the most up-to-date equipment, had lost all but 750 of its subscribers, and that a number of these had given orders for the removal of their telephones.

Telephone News Service.

The *Philadelphia North American* announces that it has through an arrangement with the Bell Telephone Company, commenced a daily telephone service of about 100 words which will be distributed by the telephone lines about 6 o'clock in the evening to a large number of points in Pennsylvania, New Jersey, Delaware and Maryland.

CURRENT NEWS AND NOTES.

AMERICAN ELECTRO-CHEMICAL SOCIETY.—The annual meeting of the American Electro-Chemical Society will be held in New York City, April 16 to 18.

THANKS FROM CONGRESS.—Senator Hoar has introduced a concurrent resolution tendering the thanks of Congress to Signor Marconi for the great benefit he has done to mankind by the invention of the wireless telegraph. Morse had to go through a good deal of this sort of thing in his time.

AMERICAN CHAMBER OF BERLIN.—At Berlin on January 29, the long-projected American Chamber of Commerce was formally founded at a meeting of the organizers under the chairmanship of Mr. Frank H. Mason, the active and efficient American Consul-General. Mr. Hermann Kreismann, an American ex-Consul, who was appointed by President Lincoln, was nominated as the first president. A hundred members were enrolled.

NEW YORK CENTRAL ELECTRICAL COMMISSION.—The New York Central Railway Company has announced that the matter of the electrical equipment of its lines in New York City and vicinity will be in charge of a commission consisting of Messrs. B. J. Arnold, Frank J. Sprague, George Gibbs and W. J. Wilgus, fifth vice-president of the New York Central Company. The electrical and mechanical force which will carry out the work under the direction of the commission will be in charge of Mr. Edwin B. Katte as electrical engineer.

ITALIAN HONORS FOR MARCONI.—A cable dispatch from Rome of January 29 says: In the Chamber of Deputies to-day Signor Frascara moved the order of the day eulogizing Signor Marconi, whose achievements were described as conferring fresh glory on Italy. Signor Batolli, in supporting the motion, moved that the order should mention Marconi in connection with the names of Galileo, Ferraris and Pacinotti. This evoked cheers. In the Chamber of Deputies on January 30, Signor Galimberti, Minister of Posts and Telegraphs, announced a bill providing for a wireless telegraph station to connect Rome and America.

ALTERNATING CURRENT RAILWAY RETURN CIRCUIT.—A patent issued January 27 to W. M. Mordey, of London, England, relates to a means of reducing the drop of the return circuit by the employment therein of a transformer. The outgoing current is passed through one winding of a transformer and the return current in opposite direction through a second winding. It is stated that by this means fall of pressure in the return main or feeder is reduced without practically affecting the pressure of the motors or of the circuit as a whole. By suitably arranged windings any desired transfer of pressure to the return main may be obtained, and the transformer may be located where most convenient.

SYNTONIC WIRELESS TELEGRAPHY.—A patent issued January 27 to Lieut.-Commander W. S. Hogg, United States Navy, describes a tuning device for use in wireless telegraphy. It consists of a combined inductance and capacity, both of which can be regulated. An outer cylinder is cut in the form of a helix, within which is a similar cylinder, the two being separated by a dielectric such as a glass tube. The inner cylinder may be moved up and down, thus varying the capacity of the device; and the sections of the spirals of the outer cylinder may be short-circuited by plugs, thereby varying the inductance. The capacity and self-induction are made so large with respect to the period of oscillation that only like instruments with large period will respond sympathetically.

FOREIGN INVENTORS AT ST. LOUIS.—A bill now pending in Congress for the amendment of the patent laws provides for extending the caveat privilege to foreign inventors. It might have been allowed to die with the present session, through the inertia of everybody concerned, but for the fact that foreign inventors of mechanisms not yet protected by patent in the United States have objected to exhibiting them at the St. Louis World's Fair next year unless they can be assured against the theft of their ideas. The Exposition management, therefore, appealed to Mr. Allen, Commissioner of Patents, to give such exhibitors a certificate of protection; but Mr. Allen responded that this would be in contravention of the fundamental theory of our patent system, and suggests that the passage of the bill referred to would accomplish the purpose desired without any straining of the existing law by construction.

WIRELESS TELEGRAPH NEWS SERVICE.—A special cable dispatch from London of January 30 says: The first attempt to supply incoming steamers with a news service was made to-day, when Reuter's Telegram Company filed with the Marconi Wireless Telegraph Company 100 words of news for the Cunard Line steamer *Lucania,* which left New York last Saturday, and which is due to arrive at Queenstown to-day or to-morrow. The wireless company, thus far, will only engage to attempt to transmit messages twenty to thirty miles from Brow Head, so the news will reach the steamer only a few hours before her arrival at Queenstown. The company will have a better chance with the Atlantic Transport Line steamer, *Minnetonka,* which also left New York Saturday, to which a news message will be transmitted to-morrow. The Min*netonka* passes twenty miles from the Scilly Islands, reaching London forty-eight hours later.

A. I. E. E. CHAPTER IN ST. LOUIS.—Electrical experts in the Louisiana Purchase Exposition took a prominent part recently in the organization of a St. Louis Chapter of the American Institute of Electrical Engineers. The meeting was held at the rooms of the St. Louis Engineers' Club in the Holland Building Annex. W. E. Goldsborough, chief of the Department of Electrical Exhibits, was chosen chairman of the St. Louis Chapter, and Girard Swope, St. Louis manager of the Western Electric Company, was elected secretary. The Exposition workers present at the meeting besides Prof. Goldsborough were Henry Rustin, chief electrical and mechanical engineer; Robert Moore, his assistant; Frank Welz, technical clerk of the Department of Electrical Exhibits, and P. E. Fansler, chief clerk of the same department. A large number of other electrical engineers were present, among them H. H. Humphrey, consulting electrical engineer; George Hessenbruch, assistant engineer to the Superintendent of Structure, Union Station; Prof. A. S. Langsdorf, Washington University, Ferdinand Schwedtmann, General Superintendent, Wagner Electric Manufacturing Company, and R. H. Klauder, consulting electrical engineer.

WATER POWER IN NORWAY.—It is announced from Christiania that the Rjukanfoss, in Telemar, known as the Norwegian Niagara, has been sold to a Swedish industrial trust, which will harness and utilize its power.

GERMAN GAS ENGINE COMBINATION.—According to a dispatch to the *Sun*, the Allgemeine Electricitäts Gesellschaft, representing the German electrical manufacturing interests, has bought a controlling interest in the Koerting Gas Engine Works at Hanover, and that the new combination will have a capital of $75,000,000.

MARCONI RELIEVED FROM MILITARY DUTY.—The King of Italy has intervened to stop the proceedings instituted by the military authorities against Signor Marconi in regard to his military service. The King has ordered that he be placed on the navy list instead of the army in such a way as will make it unnecessary for him to cease his scientific work or to return now to Italy.

FRENCH WIRELESS TELEGRAPH ENTERPRISE.—A French company has petitioned the postal authorities at Paris for permission to establish a wireless telegraph station at St. Pierre, near Newfoundland, with the object of establishing a service between there and Cape La Hague (near Cherbourg, France). It will be remembered that recently the French authorities arrested the construction of a private wireless station at Cherbourg.

"BIG BEN" LIGHTED.—A cable dispatch from London of January 24 says: "Big Ben," the famous clock in the tower of the Houses of Parliament, is being lit at last by electricity, so that its time may be read occasionally at night. It is still wound by hand, taking two men twelve hours weekly to complete the operation. It is fifteen years since the clock has been cleaned, and recently it had begun to lose time.

GOLD MEDAL FOR PROF. J. J. THOMSON.—At the recent annual meeting of Smithsonian Institute, Secretary Langley reported that during the year a number of researches under the Hodgkins fund were aided by grants to scholars in this country and abroad and that upon the recommendation of a committee a gold medal was awarded to Prof. J. J. Thomson, of Trinity College, England, "for his investigations on the conductivity of gases, especially the gases that compose the atmospheric air."

ENGLAND'S AUTO SHOW.—A cable dispatch from London of January 30 says: The automobile show opened at the Crystal Palace to-day is by far the largest held in this country. Between 500 and 600 cars are exhibited, besides 120 circulating on the grounds for the use of prospective purchasers. The car which won the James Gordon Bennett Cup in 1902 is among those on view. Although pleasure cars predominate, many heavy transport vehicles are exhibited. Altogether it is a record display, demonstrating the rapid advance made by the automobile industry in Great Britain.

NAVY LEAGUE OF THE UNITED STATES.—An organization has been incorporated with Hon. Benj. F. Tracy as president and Hon. William McAdoo as secretary, having for its object the increase of the United States Navy. The League is modeled after corresponding bodies in Great Britain and Germany, which have exercised a great influence in securing appropriations for the navies of those countries. Every man, woman and child is eligible for membership. A certificate of mmebership will be sent to any applicant upon receipt of $1.00, and the *Navy League Journal* for one year will be sent to all members. The secretary is George B. Satterlee, 52 Broadway, New York, to whom all communications should be addressed.

PACIFIC CABLE.—According to a press dispatch, the Pacific cable is proving an expensive luxury for Hawaii, and though it is being extensively used, the novelty is beginning to wear off. The newspapers complain most. The press rate is twenty cents a word and all the newspapers have been compelled to increase their subscription price, but they continue to run behind. Aside from the newspapers the cable is little used. Stock quotations are received daily from San Francisco, and the sugar men are kept informed of the state of the market. It is stated that the cable company does not expect the local office to pay, and the cable will probably be a losing proposition until it is completed through to Manila. Work on the next section of the cable has already been begun in England, and laying will probably begin from Honolulu about June.

PROJECTING ENERGY THROUGH SPACE.—A special cable dispatch from Berlin, Germany, of January 24 says: Professor Ferdinand Braun, of Strasburg University, whose application of Leyden jars in propagating electric waves is said to have enabled Signor Marconi to telegraph without wires across the Atlantic, announced before the Strasburg Scientific Society yesterday that he had discovered a method of producing electric energy of unlimited volume and projecting it into space, in the form of electric waves, to any desired distance. Professor Braun's new method secures greater accuracy of transmission through a more perfect attunement of the transmitting and receiving instruments. He thinks he has substantially reached a method of transmitting exclusively to one point of the compass, thus avoiding interference by other waves. The method, it is claimed, will work economically and simply.

NATIONAL ELECTRIC CODE.—A meeting of the National Electric Code Committee of the American Institute of Electrical Engineers, Dr. A. E. Kennelly, chairman, will be held on Friday, February 13, 1903, at 3 o'clock, in Room 57, the office of the New England Cotton Manufacturers' Association, 45 Milk Street, Boston, Mass. This will be a joint conference with a corresponding committee representing the Underwriters' National Electric Association, and representatives of the following associations are also invited to attend: National Electric Light Association, Association of Edison Illuminating Companies, American Institute of Architects, Northwest Electrical Association, Pacific Coast Electric Transmission Association. At 8 o'clock P. M., on the above date, there will be a meeting of the Boston members of the American Institute of Electrical Engineers, in conjunction with the Engineering Society of the Massachusetts Institute of Technology. Members of the above committee and representatives of the various associations are invited to attend.

MUNICIPALISM IN BOSTON.—In his annual address to the Chamber of Commerce, President Lincoln had the following to say of the Boston city government: "Men who would not be appointed to any responsible office in any financial or business organization are elected by our citizens to positions of influence and responsibility where they can vote away millions of the money of the people. Recent events have revealed to us the character and disposition of our present city government. Politicians, bankrupt in morals as well as in pocket, obtain control, and by dishonorable and corrupt methods are enabled to carry out their schemes for their personal benefit at the expense of the taxpayers. The first meeting of our common council this year surprised every one by the large amount of loan orders, amounting to $670,000. The Mayor has said that the burden per capita exceeds that of any other great city in the country. The amount which the city has the right to borrow was $3,782,000. Nearly all the amount has been authorized, and the net debt of the city has reached the sum of $52,000,000. Fraudulent purchases of land, padded pay rolls, bills for carriage hire and entertainments, reckless appropriations, and the enormous loan bills are matters that demand the earnest consideration of every patriotic citizen."

LETTER TO THE EDITORS.

Water Power vs Steam Plants.

To the Editors of the Electrical World and Engineer:

SIRS: In your issue of last week Mr. George H. Barker, formerly president of a Pacific Slope transmission plant, is reported as having expressed the opinion that while water power plants are expensive to install, yet experience on the Slope has shown that they can generate electrical power cheaper than a steam plant, even if the latter be supplied with fuel absolutely free of cost. While this statement is undoubtedly correct if the steam plant with which a comparison is made is of the kind usually employed in electrical generation, and operating under central station conditions as to load curve, the writer doubts very much if it can be substantiated in a comparison with a steam plant such as would be erected and operated for generating power in large quantities for transmission and delivery for all purposes.

It has been said that careful calculations made previous to the introduction into Buffalo of Niagara power showed that a steam plant could have been installed in that city for generating current in large quantities for all purposes at a total cost about equal to the price at which Niagara current was offered for delivery in Buffalo. In a paper read several years ago before the American Society of Mechanical Engineers, Mr. F. W. Dean, basing his figures on New England mill practice, estimated that steam power can be generated in 1,000-hp units at a total cost of $17.54 per annual hp of 10 hours daily, coal being taken at $3.85 per ton, and 5 per cent. allowed for interest, 3½ per cent. for depreciation, 2 per cent. for repairs and 1 per cent. in insurance and taxes. With fuel oil available on the slope at a cost equivalent to $2.50 per ton for coal, and with a reduction in labor account incident to its handling and less depreciation of plant attending its use, it would appear that some of the uncertain water powers of California are not so secure against competition from steam as Mr. Barker would believe.

Chicago, Ill. Jas. L. Thorne.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Motor with External Armature.—An illustrated description of a direct-current motor with external armature, designed by Mavor, especially for driving a propeller fan. The armature disc stampings are similar in form to the stampings of the stator of a polyphase motor, the windings being inserted radially from within. The magnet is a cross-shaped steel casting, with wire wound on two limbs, and with two consequent poles, the wire being held in position by pole-shoes attached to the magnet after the coils are in place. This magnet is mounted on a hollow stationary shaft, which carries the conductors from the outside to the magnet winding. On this stationary shaft is hung the external armature with a running bushed bearing at each end. The running bush is supported on the end plate carrying the armature discs and winding, and is formed at the inner end with a groove and projection, the groove communicating by openings with the outside of the running bush, over which is placed an oil-catching vessel. At the outer end of the running bush is fixed a flange, dipping below into the oil in the catcher reservoir. From this running disc the oil is thrown on to a stationary disc, forming part of and communicating by grooves on its inner face with channels in a fixed bush attached to the stationary shaft. The oil thus circulates from the catcher reservoir by the running disc, the stationary disc and grooves in the stationary bush to the running bush being thrown off again at both ends of the running bush into the oil catcher reservoir. The advantages are reduced weight and good ventilation of the armature.—Lond. *Elec. Rev.*, January 16.

REFERENCES.

Design of Small Dynamos.—A full report of the discussion which followed Mavor's recent paper on this subject. The matter is also discussed editorially at some length. Mavor emphasizes that it is especially necessary in small machines to consider the speed at which the machine has to be run and the depth of the slot, with special reference to the iron losses; heating, he maintains, is the only limitation; for, in these small machines, commutation and efficiency may generally be left to take care of themselves.—Lond. *Elec.*, January 16.

Single-Phase Motor.—Girault.—An illustrated description of a single-phase alternating-current motor, patented about ten years ago by the Oerlikon Company. It has a fixed commutator and revolving brushes and starts under load. It is interesting in view of the recent proof (Heyland, Latour) of the peculiar properties of the use of armature windings with commutator for alternating-current motors.—*L'Ind. Elec.*, January 10.

Power.

Power Distribution in Great Britain.—A statistical table giving particulars concerning the large electric power distribution companies in Great Britain, working under Parliamentary powers. The only one of these companies which is really in active operation is the Newcastle-on-Tyne Electric Supply Company, which supplies electric light to a large part of Newcastle and power to a number of large manufacturing works, as well as to a line of tramways. The second company on the list, the Midland Electric Corporation for Power Distribution, has a finely equipped plant and an extensive distribution system, and as it is also in a most favorable position, it may be expected to soon be working with economy on a heavy load. The remaining power companies are either working under more or less temporary arrangements or are still in the earlier stages of their development.—Lond. *Elec.*, January 16.

REFERENCE.

Steam Turbine.—Reyval.—The first part of a detailed and well-illustrated description of Parsons' steam turbines.—*L'Eclairage Elec.*, January 17.

Traction.

New York.—Wheatly.—An article on passenger traffic problems in Greater New York. A table gives the increase in population in New York City during the last five decades, and it is shown that with contiguous territory the population of the New York district amounts to about 4,500,000 people. The traffic on Manhattan Island amounted in 1900 to an average of 388 rides per inhabitant, and in 1903 it is estimated at 415 rides per inhabitant per year. Statistics are also given of the passengers carried for a number of years back and also for recent days and weeks. The total travel into and out of the business district during the busiest hour is estimated at 250,000. The writer points out that no additional surface or elevated lines have been built in the business district during the past twenty years, although the traffic has quadrupled. A summary is given of the delays over five minutes in length in the street railway traffic in New York City for 18 days in December due to causes beyond the power of the company. Another table gives the number of vehicles crossing the tracks at different hours of a day selected for making the count; and a third gives the miles of track, car miles, gross receipts, population and gross receipts per mile of track, etc., for seven leading cities in the United States. The writer believes that the trains in the Subway, if run at 30 miles per hour, cannot be operated on a shorter interval than from 2 to 2½ minutes, and estimates the number of cars which can be passed through the tunnel at 540 per hour, giving a total seating capacity for 28,000 passengers and a total carrying capacity per hour in each direction of 43,000 people. He does not believe that this will have much effect on the total traffic of New York, which at present, in the busiest hours, amounts to 142,000 people per hour. Diagrams are also given to show the obstructions to the streets now caused by the excavations in building the Subway.—*St. R'y Jour.*, January 10, 17.

REFERENCE.

Accumulator Traction.—Izart.—An article in which he gives some formulas for calculating the storage batteries required for use on street cars. He starts, however, with the sweeping statement that an economic solution of the traction problem prevents the use of batteries in cars.—*L'Ind. Elec.*, December 10.

Installations, Systems and Appliances.

Behavior of Synchronous Converters in Traction Installations with Stationary Accumulators.—Banti.—An article on a singular phenomenon which he has observed with rotary converters when set to charge a battery of storage batteries. The charging current was found to be highly pulsatory, though the same converter, working at the same actual power on the same supply, at the same voltage, but delivering its output on a plain non-inductive resistance, gives a perfectly smooth continuous current. The experiments were made at a traction station in Rome, and the converter was a single-phase apparatus, rated at 60 kw. The slightly pulsating current generated by the converter acquires a notably greater pulsation when working

upon a battery, because the battery, by offering a counter e.m.f., produces on the current a greater pulsation than that due to the converter itself. He then examined whether an ordinary continuous-current dynamo also presented, or at least indicated, the same phenomenon; this might have been expected, as a direct-current dynamo furnishes of itself a more or less undulating current; however, the result was negative, as no pulsations were found in the dynamo current when charging the battery. His conclusions are summed up as follows: When a synchronous converter operates upon a non-induction resistance, it furnishes a continuous current with slight pulsations; it would be an error to calculate the power generated from the product of voltage and current if these are measured by hot wire instruments; the effective power measured by a wattmeter is found to be less than the apparent power, and in the case considered about 5 per cent. When the converter operates on a battery of accumulators, the said pulsations increase in amplitude and the continuous current becomes markedly pulsatory; the effective power generated by the machine is much less than the apparent power obtained as the product of volts and amperes measured by hot wire instruments, being, in the case considered, about 15 per cent. less. To obviate this inconvenience, or, rather, to cause the converter to operate in an identical manner whether on accumulators or on ohmic resistances, it suffices to insert into the circuit a suitable inductance capable of being regulated step by step; this inductance absorbs in itself a very small amount of energy.—Lond. *Elec.*, January 16.

British Three-Phase Plant.—A well-illustrated description of the Erith Electric Works, which is one of the first plants in Great Britain using the three-phase system for distribution. On account of the scattered nature of the district three-phase currents are transmitted at 3,000 volts. The secondary distribution is on the four-wire, three-phase system, the secondaries of the transformers being joined up in star connection and the fourth wire being run from the middle point. As 200 volts is the declared pressure at the consumers' terminals, the pressure between any two outers is 346 volts; the middle point of the star will probably be earthed. In addition to private lighting there will be a considerable amount of public lighting with Nernst lamps. About 580 Nernst lamps, partly ¼ and party ½ amp, will displace the present oil lamps. They will be connected as in private lighting, between the outers and the centers of the transformer secondaries. In addition to this there are 18 arc lamps of 15 amp. The plant, and especially the switchboard, are described in detail and are well illustrated.—Lond. *Elec.*, January 16.

London Supply Station.—An illustrated description of the electricity works of the Central Electric Supply Company, which is now being completed and is to support other existing stations in congested areas of London. The Central works generate 6,000 volts, three-phase current, this pressure being delivered at the terminals of the dynamos and without the assistance of step-up transformers. The current is led by three-core underground cables to existing stations, where it is converted into direct current at the voltage of the distributing network, which is in one case a 440-volt, three-wire system, and in the others 220 volt, two-wire. The conversion into direct current is also effected without the intermediary of transformers; induction motors are used, taking three-phase currents at 6,000 volts, and these motors are directly coupled to the direct-current generators.—Lond. *Elec.*, January 9.

WIRES, WIRING AND CONDUITS.

REFERENCE.

Transmission Wires.—OTTO.—A mathematical article in which he gives formulas for calculating the sag of an overhead wire, as a function of the distance between two poles, the temperature, the wind pressure, and the tension.—*Elek. Zeit.*, January 15.

ELECTRO-PHYSICS AND MAGNETISM

Excited Radio-Activity.—RUTHERFORD.—An article in which he shows that the production of excited radio-activity is one of the properties of the emanation from thorium and radium. It is due to the deposition of radio-active matter which is derived from the emanation given out by these bodies. Excited radio-activity is transmitted by positively charged carriers produced from the emanation, which travel in an electric field with about the same velocity as the positive ions produced in air by Röntgen rays. This velocity is about 1.3 cm per second for a drop of 1 volt per cm. These positively charged carriers are due to the expulsion of a negatively charged body from the molecule of the emanation. The emanations and the matter which gives rise to excited activity are the result of a succession of chemical changes occurring in radio-active matter. In thorium there is evidence of at least four distinct chemical changes.—*Phil. Mag.*, January; abstracted in Lond. *Elec.*, January 16.

Optic Resonance.—KOSSONOGOFF.—A description of experiments on resonance. A selective reflection of electromagnetic waves may be obtained by means of a mirror composed of resonators of a certain length. The present author shows that it is possible to produce a similar resonance for wave lengths belonging to the visible spectrum. For this purpose the components of the "mirror" must be exceedingly minute. He describes two good methods of producing the resonant mirrors, one of them involving the projection of a spray of very dilute solution of a salt or metal upon a hot surface, and the other consisting in cathode disintegration. The color of the films varies according to the size of the grains and their distribution; it also varies with the temperature, and with immersion in other dielectrics. Gold, silver and copper mirrors may be obtained of any color. The grains of platinum are too small to reflect any visible light. But the author has obtained at least one platinum mirror which has a deep blue color, and has also discovered optical resonance in lepidoptera.—*Phys. Zeit.*, January 1; abstracted in Lond. *Elec.*, January 16.

Effect of Temperature on Hysteresis Loss.—MILLS.—An account of some experiments on the effect of temperature upon the hysteresis in an iron and in a tungsten alloy, the method being that devised by Searle, in which the energy dissipated in hysteresis is determined by observing the throw produced in the movable coil of a sensitive electrodynamometer. He found that the curves representing the hysteresis loss in iron as a function of the temperature, are practically straight lines until the critical temperature is reached, except that for the higher inductions the loss is slightly larger in proportion near the critical temperature. The rate of change in the permeability of iron as the temperature approaches very near to the critical temperature, is so great that, throughout a range of several degrees in this region only approximate values of the hysteresis could be obtained. Moreover, at such high temperatures the iron is in such a critical state that it was found that the process of demagnetizing by reversals does not entirely wipe out all the effects of previous magnetism, although the residual effect is only noticeable in extremely weak fields. In the case of a specimen containing 4.5 per cent. of tungsten, the passage from the magnetic to the non-magnetic condition is much more gradual, and the demagnetizing process, even at the highest temperatures, removes all traces of residual magnetism. The variation of hysteresis loss with temperature in the neighborhood of the critical temperature can, therefore, be much more satisfactorily examined with this alloy than with iron. As the temperature is raised the rate of fall of hysteresis increases, reaching a maximum at about 350° C.; then, as the temperature is increased, the hysteresis decreases less rapidly.—*Phil. Mag.*, January; abstracted in Lond. *Elec.*, January 16.

A Thermomagnetic Phenomenon in Gases.—ASCHKINASS.—A paper on a curious phenomenon described some 15 years ago by Nernst. When a heated metallic bar is introduced between the poles of an electromagnet, the temperature gradient in the air about the hot body is profoundly modified by exciting or demagnetizing the magnet. If a thermometer is placed beside the hot body, but not in the lines of force which pass through it, the mercury falls by 2 or 3° on exciting the magnet. No effect is observed, however, if the lines of force penetrating the hot body also penetrate the thermometer. The present author attempts an explanation of this curious phenomenon. He uses a copper rod 25 cm long and 6 mm wide, and places the axis of the electromagnet vertically. He finds that there is, indeed, a decrease of temperature near the rod, but an increase further away, and thence concludes that the hot air is diverted by the magnetic field. The phenomenon is connected with that described by Faraday, in which a current of hot air is driven through a tube into a magnetic field. It is due to the fact that hot oxygen is strongly diamagnetic with respect to the cold gases. The experiment fails with nitrogen or carbonic acid.—*Phys. Zeit.*, January 1; abstracted in Lond. *Elec.*, January 16.

ELECTRO-CHEMISTRY AND BATTERIES.

The Storage Battery as an Electrolytic Cell.—REED.—A theoretical article. All galvanic batteries, whether primary or secondary, are electrolytic cells, although electrolytic cells are not all galvanic batteries. The fundamental characteristic of electrochemical action is change of chemical valency; at the cathode the change of valence always tends to liberate an electropositive body from combination, and always tends to cause an electronegative body to enter into combination; at the anode the change of valency always tends to liberate an electronegative body from combination, and always tends to cause an electropositive body to enter into combination. This is the distinguishing characteristic of all electrolytic action, and the only one. Changes in chemical valencies may also occur in thermochemical action. The essential and universal difference between thermochemical and electrochemical reactions is that, in thermochemical reactions these two opposing changes of valency take place in two individual atoms or atomic groups which are at the same place and in contact, the energy change being from chemical energy to heat, and from heat to chemical energy; while in electrochemical reactions the two opposite changes in valence take place in atoms or molecules which are not in molecular contact, but are physically separated by an intervening compound-conducting body, the energy change being from chemical energy into electrical or from electrical into chemical energy. In an electrochemical action the transformation of energy always occurs at the electrodes, and a corresponding e.m.f. is either developed or absorbed at each electrode. If the total e.m.f. is positive, that is, if the electrolytic cell is capable of generating electrical energy at the expense of its chemical energy, it is called a galvanic battery. Every electrolytic cell which generates electric energy when a current passes in one direction will generate chemical energy, when the current passes in the opposite direction. There is no essential difference between a primary and a secondary or storage battery, but a difference only in the manner of using the cells and in their origin. If a battery is manufactured without the aid of an electric current, and is thrown away after its chemical energy is once dissipated, it is called a primary battery. If the cell has its chemical energy restored after discharge by passing a current in the opposite direction, it is called a storage battery. An apparatus may, however, generate chemical energy without actually storing it, on account of the accidental circumstance that the chemical products formed are mechanically lost in the process of generation; if any of the products of the electrochemical reaction formed in charging or discharging a battery are allowed to escape as a gas, or to precipitate as an insoluble product, they cease to be a part of the electrochemical system and cannot be available in that system for a subsequent action. But the author claims that this is more an accidental than an essential feature and no classification of electrochemical cells into reversible and non-reversible should be founded upon it. The author discusses at some length the action in the gas battery.—*Electrochem. Ind.*, December.

Table of Electrochemical Equivalents.—HERING.—A large table of the electrochemical equivalents and nine columns of their derivatives, which include such quantities as grams and pounds per ampere and watt-hour, kilograms and pounds per horse-power-hour, and in each case their reciprocals, so that all long divisions are avoided. It includes all but the very unusual elements, and in many cases two and three valencies which still further saves calculations. It also contains general formulas by means of which any other equivalents or derivatives not given may be calculated. The whole table has been carefully calculated and is based on the atomic weights adopted by the American Chemical Society and on the electrochemical equivalent of silver as adopted by the international congress. An auxiliary table gives the valencies which the elements have in their compounds, which latter are enumerated. There is also a set of typical examples showing how to calculate the amounts of any materials, either elements or compounds, corresponding to a given current or energy; these examples include many of the more unusual and complicated cases not generally explained in text-books. The basis of the method is that, knowing the change of valency, the required constant is found directly from the table. The older, indirect method, is also described. It is based on calculating some one convenient quantity in a complicated reaction and then by means of the complete equation calculating the desired quantity; this involves a quantitative knowledge of the complete reaction, while the other method does not, but gives the result directly. These examples are of the nature of a key to the solution of the more complicated calculations involving Faraday's law.—*Electrochem. Ind.*, January.

Electrolytic Refining of Gold.—TUTTLE.—An illustrated description of the Wohlwill process of gold refining, used at the Philadelphia United States Mint. The feature of the process is the electrolyte, which is composed of a gold trichloride solution, rather strongly impregnated with free hydrochloric acid; the latter addition is necessary, because if a gold anode be placed in a neutral or only slightly acid solution of gold chloride, gold will be deposited on the cathode, but little or no gold will be dissolved from the anode, free chlorine being given off instead. The temperature of operation is 50 to 55° C., this increased temperature serving to reduce the voltage required, and at the same time to diminish the amount of free acid necessary to suppress evolution of chlorine at the anodes. Circulation of the electrolyte is also necessary. The cost of the hydrochloric acid required in the bath is 20 cents per 1,000 ounces of deposited gold. Any platinum present in the bullion can be recovered; it dissolves, but is not deposited with the gold. When the electrolyte becomes sufficiently charged with platinum, the gold is first precipitated by sulphur dioxide and reserved; then the platinum remaining in solution is separated as ammonium platinum chloride; lastly the copper is recovered by passing the wash waters over iron scrap. He does not treat by this process bullion having a fineness of less than 940 gold.—*Electrochem. Ind.*, January.

The Present Metallurgy of Aluminum.—J. W. RICHARDS.—An article giving historical notes on the development of the aluminum industry and a discussion of the scientific principles of the only process by which aluminum is now made, i. e., the process of Hall and Heroult. The principle is that the melted double fluorides of aluminum and more electropositive metals can dissolve a considerable proportion of their weight of the relatively infusible alumina; when such a solution is electrolyzed, aluminum and oxygen appear at the two electrodes until the dissolved alumina has been almost entirely eliminated; by the addition of fresh alumina the process can be made continuous, while the solvent bath material remains unaffected by the operation. The way by which Hall and Heroult arrived at this process is sketched, together with the actual method of operation in use at present. To obtain pure aluminum it is necessary to use pure alumina; this requirement has led to considerable improvement in the manufacture of aluminum. The author finally discusses in detail the reactions taking place in the Hall process from a scientific point of view.—*Electrochem. Ind.*, January.

Canadian Nickel Industry.—A statistical review of the present situation of the Canadian nickel industry. The Canadian and Orford Copper Companies, which have been consolidated with the International Nickel Company, are still the most important producing concerns in the Dominion. The principal works of the Canadian Company are at Copper Cliff; the surface plant is producing from 500 to 600 tons of ore daily for shipment to the roast yards at Copper Cliff. Extensive smelting works have recently been completed for re-treating the low-grade mattes, with the result that their metal contents have been raised from 30 to about 70 per cent. For the final separation of the copper and nickel this material is treated by a series of smeltings with various alkalis, followed by an electrolytic treatment for the purpose of producing pure nickel. One of the companies outside of the combination is the Mond Nickel Company, whose mines at Victoria have been very considerably developed during the past year, the Bessemer process having been put down for turning out matte. The product is a high-grade article, carrying about 80 per cent. metallic contents in equal proportions of nickel and copper, the iron in the one being at the same time entirely eliminated. This matte is refined in England by Mond's own process. During the past ten years 1,306,722 tons of nickel, copper and copper ore, producing 26,606 tons of metallic nickel and 28,070 tons of metallic copper, have been produced in Ontario, the value of the nickel being over $20,000,000 and the value of the copper nearly $6,250,000. The rate of development has been very much greater during the last five years than in the first half of the decade. The most striking development has been in the production of high-grade matte, which in 1897 only amounted to 328 tons, whereas last year it was 15,546 tons.—Lond. *Eng'ing*, January 9.

Electrolytic Rectifier.—HOSPITALIER.—An account of the results of tests made with the Nodon "electrolytic valve" (aluminum rectifier) at the School of Industrial Physics and Chemistry of the City of Paris. Four cells were used, according to the arrangement of the

Wheatstone bridge, which was first used by Graetz for this purpose; the one diagonal line is supplied with the alternating current to be rectified; the other contains the apparatus in which the rectified current is to be used. As well known, this arrangement enables one to utilize both half curves of the alternating current to be rectified. The frequency of the alternating current used in the experiments was 42, and an electrolytic valve of the 5-amp type was employed. The rectified current was used to charge a storage battery of 42 cells in series. The wave forms of the currents and e.m.f's were determined by means of the ondograph and are reproduced in diagram. The efficiency of the rectifier was found to be about 70 per cent., and the wasted energy appears in the form of heat, so that the temperature of the electrolyte increases. This is said to have no other inconvenience than to cause an evaporation of the liquid so that water must be filled in at intervals. The electrolytic rectifier behaves like a condenser, the current being about one-quarter period in advance of the e.m.f.; the deformations of the current wave are the same as are obtained with a condenser and are due to the presence of higher harmonics.—*L'Ind. Elec.,* December 10.

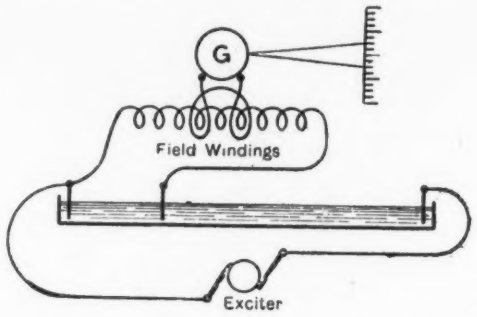
REFERENCES.

Calcium Carbide and Acetylene.—A review of the present conditions of this industry in the United States, with a brief outline of the chemistry of the subject.—*Electrochem. Ind.,* December.

Electrometallurgy.—BEADLE.—In a continuation of his series on electrometallurgical problems the author discusses the manufacture of aluminum, magnesium and sodium.—Lond. *Elec. Rev.,* January 9.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Measurement of Magnetic Flux.—THORNTON.—A communication referring to Beattie's description of the quantometer, recently abstracted in the Digest. He points out that to measure the flux in any part of a large dynamo field magnet it is not necessary to use any special instrument other than a dead-beat, moving-coil galvanometer. The arrangement is shown in the adjoining diagram.



MEASUREMENT OF MAGNETIC FLUX.

By increasing or decreasing the field current slowly by a liquid rheostat, the current induced in an exploring coil of one or two turns may be kept so steady that the galvanometer deflection can be noted every few seconds, and the mean deflection can be obtained over the total time of operation with an accuracy within 2 per cent. of a photographic or automatic recording method. The product of the mean reading and the total time is a measure of the electrical quantity or of the magnetic flux, according as the galvanometer reading is calibrated for current or voltage. Stoney first suggested taking the readings in this way, and the present author has found it in practice to work very well, the most important point being to move the slide in the liquid rheostat at a constant rate, starting and stopping slowly.—Lond. *Elec.,* January 9.

Universal Permeameter.—PICOU.—An illustrated description of a permeameter which is called "universal," because it is adapted as well to tests of iron sheets as of wires. The inherent difficulty in the ordinary permeameter is due to the joints between the piece under test and the other parts of the apparatus; an air-gap is thereby introduced, which may be very small, but may cause appreciable errors. In the author's method these errors are eliminated. In the adjoining diagram, B_1 and B_2 are two iron horse shoes and b is the piece under test. Each of these three parts is provided with a magnetizing coil. If at first current is supplied to the coil of B_1 and B_2 only, but in such a sense that the fluxes in these both parts have the same direction, nothing will happen in the piece under test, the two ends of which are at the same magnetic potential; but the flux passes through all the joints. If then the current of the coil of B_2 only is reversed, then the fluxes due to the magnetizing coils of B_1 and B_2 are opposed to each other and close themselves entirely through b. The magnetic flux is thus diminished by the introduction of the reluctance of b into the circuit. To bring the magnetic flux back to its original value, it is only necessary to send a current in

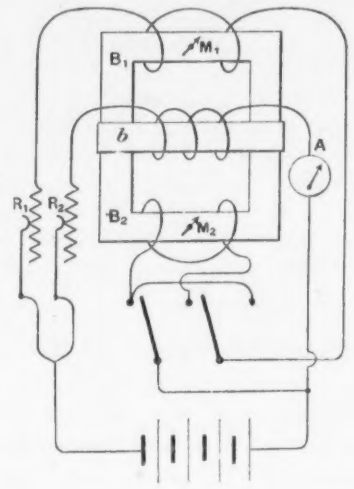


DIAGRAM OF CONNECTIONS OF PERMEAMETER.

the proper direction through the magnetizing coil of b. This current is measured by the ammeter, A, and this gives the corresponding magnetomotive force. Now, this corresponds exactly to the magnetizing of the piece b under test alone, the influence of the other parts of the apparatus and of any joint being eliminated.—*Bull. Soc. Int. des Elec.,* December; *L'Ind. Elec.,* January 10.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Wireless Telegraphy.—WILKE.—An illustrated description of portable stations for wireless telegraphy of the system of Braun and Siemens & Halske, and their application in the German army.—*Elek. Zeit.,* January 15.

Indicators at a Distance.—HENTZE.—A brief illustrated description of an electro-hydraulic instrument for indicating at a distance the speed of axles, machines, motors, etc.—*Elec. Zeit.,* December 18.

MISCELLANEOUS.

Success of Municipal Ownership in Great Britain.—DONALD.—A continuation of his article. The writer has taken up the subject of the gas distribution and cites instances to show that the rates charged for gas are lower in towns where the plant is owned by the municipality. He also claims that the same is true in regard to electrical power and telephones. At the same time he claims that a profit is made from these undertaking which reduces the tax rate considerably; he quotes the ostensible profits made by some cities.—*St. R'y Jour.,* January 10.

Biographical—This continuation of the serial on pioneers in electrochemistry, gives the life and work of H. Y. Castner, with portrait.—*Electrochem. Ind.,* December.

New Books.

ELEKTROMOTOREN FUR GLEICHSTROM. Von G. Roessler. Berlin: Julius Springer. 136 pages, 49 illustrations. Price, 4 marks.

As is indicated by the title, this is a text-book on the construction of motors for continuous currents, and is chiefly intended for the use of electrical students. The book commences with an exposition of the general principles of electrical currents, succeeded by a discussion on electromagnetism. The various forms of motors for continuous currents are then taken up in half a dozen succeeding chapters, in which the magneto, electromagneto, series motors and shunt and compound, corresponding generators are treated in such a manner as to draw particular attention to the *differences* between the motor and the generator. In conclusion there is a chapter on hysteresis. The book is a text-book and deals with little less than the theory of design, without attempting to show any inevitable reconciliations necessary to adapt even the best theories to practical constructions.

BOOKS RECEIVED.

THE HOW AND WHY OF ELECTRICITY. By Charles Tripler Child. New York: *Electrical Review*. 126 pages, 39 illustrations. Price, $1.00.

DESIGN OF DYNAMOS. By Silvanus P. Thompson, D. Sc., F. R. S. New York: Spon & Chamberlain. 253 pages, 100 illustrations. Price, $3.50.

ELEKTROMAGNETISCHE AUFBEREITUNG. Handbuch fur Elektrochemie. By F. Langguth. Halle: Wilhelm Knapp. 84 pages, illustrated. Price, 3 marks.

PHYSICO-CHEMICAL TABLES, VOL. I. Chemical Engineering and Physical Chemistry. By John Castel Evans. London: Charles Griffin & Co. 548 pages. Price,

PROCEEDINGS OF SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION; TENTH ANNUAL MEETING. New York: *Engineering News* Publishing Company. 300 pages. Price, $2.50.

Directory of Electrical Societies, Etc.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, Secretary, Ralph W. Pope, 95 Liberty Street, New York. Meetings: February 27th, "Railway Train Lighting," Wm. L. Bliss, Lamar Lyndon and A. J. Farnsworth; March 27th, "High-Tension Lines," Ralph D. Mershon; April 24th, "Tendencies of Central Station Development," H. A. Lardner, Philippo Torchio and Peter Junkersfeld.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES, Secretary, W. H. Johnson, Philadelphia, Pa.

CANADIAN ELECTRICAL ASSOCIATION, Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Toronto, Ont., 1903.

THE ELECTRICAL TRADES SOCIETY (Member National Electrical Trades Association), Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets every second Friday of each month.

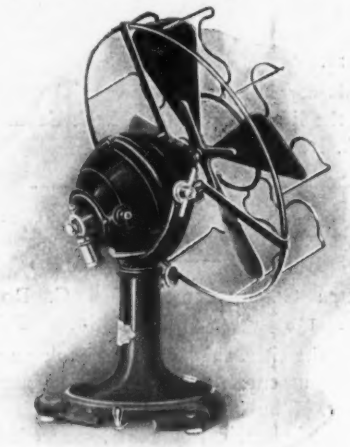
ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE, Secretary, Wm. J. Davis, Ithaca, N. Y.

ENGINE BUILDERS' ASSOCIATION, F. P. Ide, Springfield, Ill., Secretary.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS, Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Atlantic City, N. J., September, 1903.

Lundell Fan Motors.

The Lundell fans, manufactured by the Sprague Electric Company, have been long and favorably known, and a detailed description at this time seems hardly necessary. They are made in various sizes and types, which are sufficient to meet all requirements of the trade. Last year the 12-inch and 16-inch swivel and trunnion desk and bracket models were introduced and received the cordial indorsement that has always been accorded the Lundell patterns.



DESK FAN, SWIVEL AND TRUNNION TYPE.

The Lundell fan motors are of the bipolar round type and have a single field coil, which energizes both pole pieces, thus insuring a simplicity and compactness that is ideal. The motor is non-sparking and has a strong torque permitting the use of fan blades of considerable pitch, so that they will drive a large volume of air at a given speed with a small amount of current. The fan blades are firmly riveted to a spider, so that there is not the remotest chance for a blade to fly loose under the highest speed at which a fan motor can be run. The motor has self-oiling and self-aligning bearings. The self-oiling cups invented by Mr. Lundell have been found admirably adapted to their work.

All styles and patterns of Lundell fans are carefully finished and tastefully decorated. The guards are strong in construction and artistic and graceful in appearance. The fans run easily and quietly and require practically no attention. The Lundell fans have stood the test of service in all parts of the world and the manufacturers are anticipating a large business during the coming season.

Moskowitz System of Electrically Lighting Steam Railway Cars From the Axle.

In this system of car lighting each car has its own portable self-contained lighting plant, able at all times, in motion or at rest, to furnish current for lamps or fans. Each car carries a small generator driven from the revolving car axle; also a small storage battery. Cars run at all speeds up to 80 miles per hour, and the variable axle rotation is communicated to the armature of the generator. This would cause a variable electrical output, but owing to the completeness in which this system is worked out in controlling the generator, the voltage remains practically constant.

The generator is an iron-clad machine, built especially for use in railway car trucks, and is spring suspended. It delivers its full output of electrical energy when the car attains a speed of 15 miles per hour. At 60 miles per hour it has, therefore, quadrupled its armature speed, and it is thus apparent some automatic regulation or control must be introduced to prevent lamps and batteries from being destroyed.

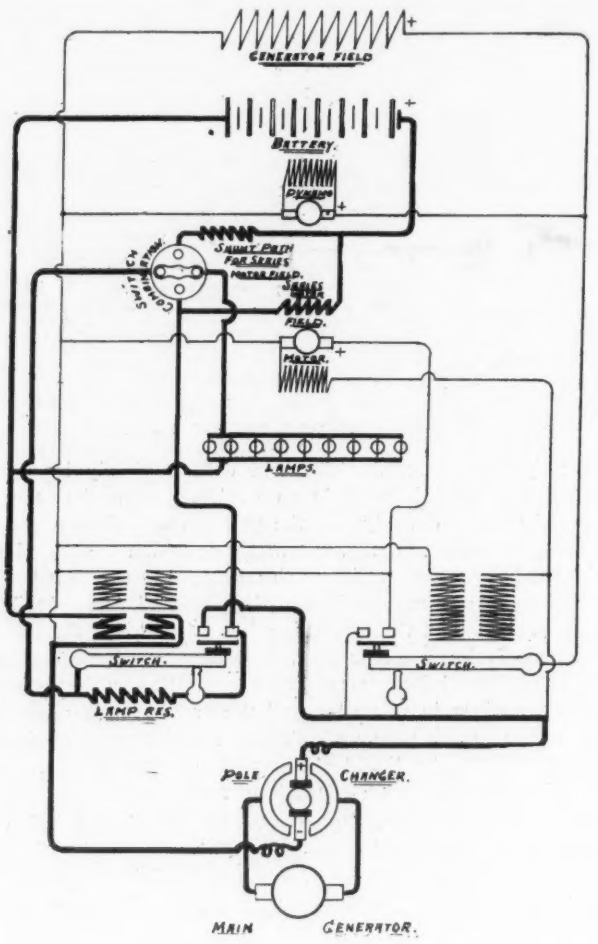


FIG. I.—DIAGRAM OF CONNECTIONS, AXLE-LIGHTING SYSTEM.

The regulation of the generator is accomplished by a small motor-

generator placed for convenience on the switchboard in the car. This motor-generator acts as exciter and regulator for the generator in the car truck. The exciter is entirely under electric control. The motor-generator has both of its armatures wound on one shaft and runs in oilless bearings, forming a very small and compact machine.

As railway cars travel in either direction, it is necessary that provision be made to cause the external current from the generator to flow in one and the same direction, irrespective of the rotation of the car axle. The pole changer under discussion rectifies and keeps the current flowing in the proper direction in a direct and simple way, altogether eliminating the use of gears, cams or additional bearings. A steel projection secured to the armature shaft of the generator is caused to operate a substantially constructed electric switch in either one or the other direction. This projection having performed its work is withdrawn by centrifugal force caused by the rotation of the armature shaft. When the car reverses its direction the same action occurs in an opposite sense. It will be understood that the projection having been withdrawn at about 4 miles per hour of the car's speed there is no wear taking place, as all movements of the pole changer cease until the car slows down again.

The method of power transmission consists of a belt of special material, the tension of which between the two pulleys is kept approximately constant through the medium of a spring.

When the car is at rest the battery supplies current to the lamps. It will be seen that the pole changer switch on the accompanying diagram occupies a neutral position, but the car under motion will cause the switch blades (marked positive and negative respectively) to engage or make contact alternately with either one or the other set of contacts. The result is that the current is always rectified in the pole changer.

Now, assuming the car has attained a speed of 10 miles per hour, the main generator armature excites its own field as an ordinary shunt machine. It also supplies current to the small dynamo, starting the same as a motor. It also excites the shunt field of the small motor. It will be understood that the small motor and dynamo armatures are wound on one shaft. The electromagnetic switch on the lower right-hand side being shunt wound and connected across the pole changer, will attract its armature, thereby closing its upper switch and opening its lower one. This closes the armature circuit of the small motor and at the same time cuts out the shunt field from the large generator; it also cuts the current from the small exciter dynamo. The small motor now being in motion and driving the small dynamo, the latter exciter now excites the field of the large generator acting as an independent exciter for the main generator. When the car reaches a speed of about 15 miles per hour the compound electromagnetic switch on the lower left-hand side of the diagram attracts its armature, thereby closing the upper switch and opening the lower one. This switch closes the external circuit between the generator and the battery, or between the generator, the battery and the lamps, causing the main generator to light the lamps direct and charge the battery as well. The closing of this switch also introduces a small lamp resistance, as shown on diagram, which was previously short-circuited to protect the lamps from the additional voltage necessary to overcome and charge the battery. Further reference to the diagram shows a series field winding for the small motor. The series winding on

FIG. 3.—VIEW OF SWITCH CABINET.

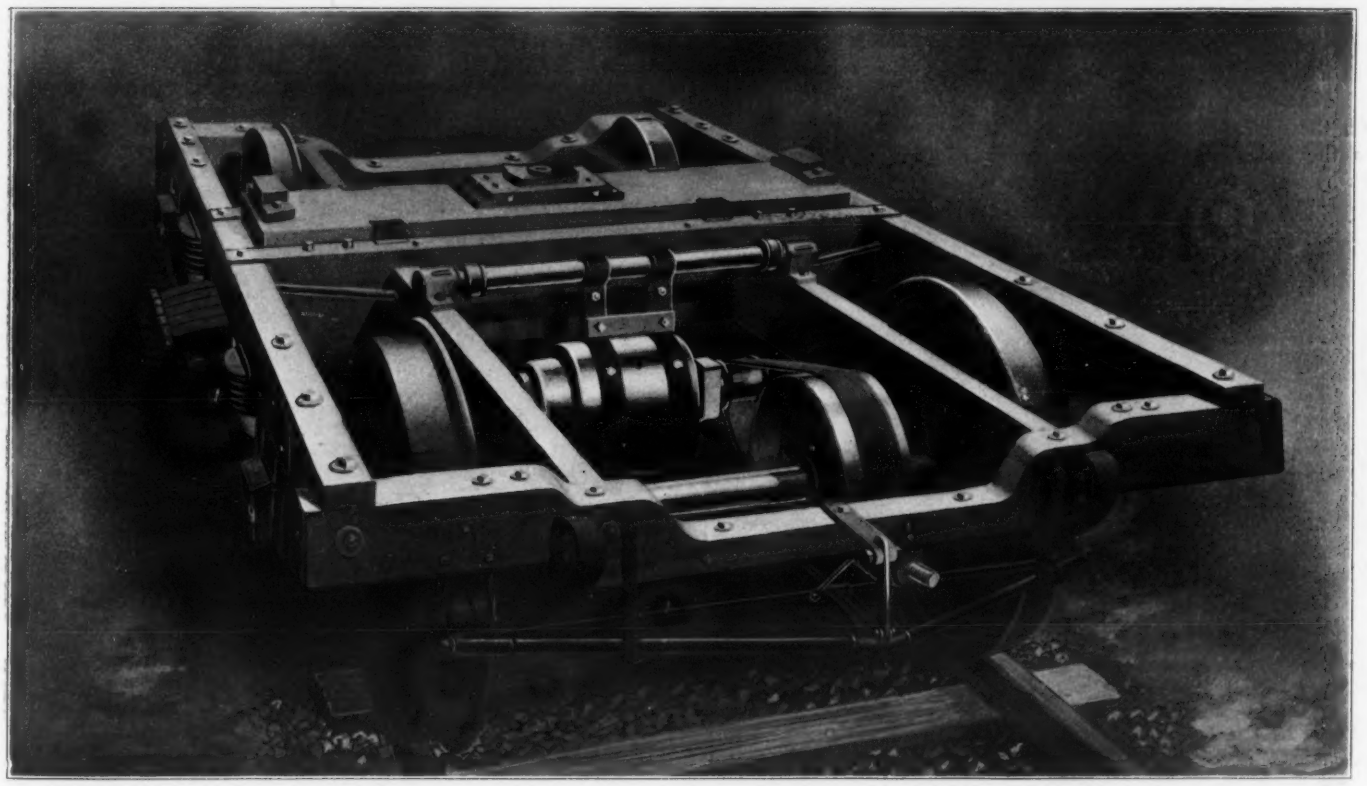


FIG. 2.—VIEW OF CAR TRUCK SHOWING GENERATING APPARATUS.

the motor is cumulative, and since the full load of the main generator passes through the series winding, the effect is to cause the small motor to slow down in its speed and the small generator to deliver less current to the field of the large generator. This continues as a perfect balance through all speeds up to and above 80 miles per hour, maintaining the e.m.f. of the main generator approximately constant through exceptionally wide ranges of speed.

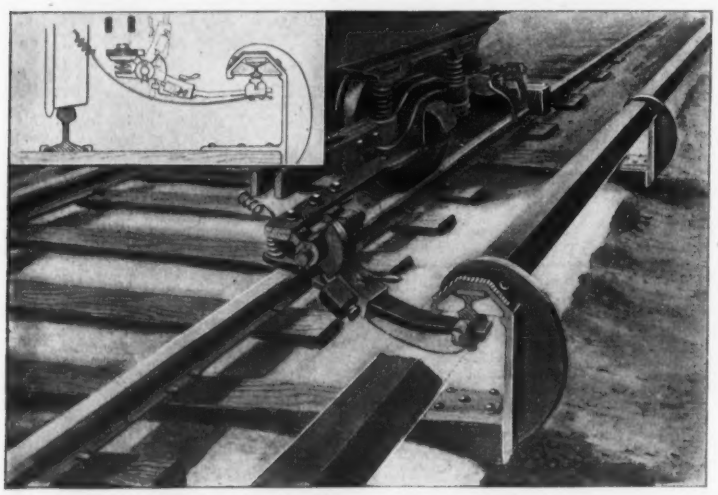
During the day when the lamps are not lighted it is desirable to charge the battery with a larger current. This is compensated for with an additional resistance shunt path for the series field of the motor-generator, and is controlled by a combination switch which is cut in when the lights are turned off manually. As the speed of the car falls below 15 miles per hour there is a tendency on the part of the battery to reverse itself through the main generator, causing the compound on the make and break switch to become differential and neutralize its magnetism. This allows the iron armature to fall down, thereby opening the circuit between the battery and the generator. An examination of the diagram will show that when the automatic switches open there is practically no current flowing, thus insuring long life to them. The system above described has been developed by the United States Lighting & Heating Company, of New York.

Walkins Inverted Third Rail System.

The accompanying illustrations show an inverted third-rail system recently patented to Louis E. Walkins, of Springfield, Mass. It consists of the ordinary rail turned upside down and suspended at proper intervals by a bracket to one side of a line of rails so formed to allow a sliding trolley shoe, projecting from the car truck, to slide on the under side tread of rail conductor inverted and secured to brackets about 15 feet apart.

The third rail is fastened to the brackets by a lock-joint insulated wedge, and the full length of the third rail, top and both sides, are insulated, so that contact cannot be made by man or beast, unless deliberately reaching underneath the rail. The inverting and covering of the rail keeps it always dry and prevents the accumulation of ice, snow, sleet or rain, thus stopping much of the delay caused through loss of contact, flashing and sparking of the shoe.

Such a system is claimed to remove in a simple and efficient manner all of the dangerous features of a third-rail conductor as now in use on the Elevated Railways of New York, Chicago and Boston, meets the objection to the third-rail conductor through causing delays by accumulation of ice or snow on the tread of power conductor, obviates flashing and sparking of shoe, leakage of power, and loss of current by dampness. It is stated that careful estimates show that the cost of installation of this system is but a very little more per mile than the present system of third rail in use on the Second Avenue line of the Manhattan Elevated Railway.



INVERTED THIRD-RAIL SYSTEM.

The inverted third rail trolley shoe has been designed with a view to simplicity and the highest degree of efficiency, and to obtain results overcoming many of the obstacles met with in the use of other trolleys or trolley shoe devices. It combines great strength and flexibility and can be readily thrown to one side, and up against the car-truck at such times as needful to remove it out of the way. It is stated that a series of practical tests has thoroughly demonstrated that as improved the trolley shoe under any momentum of speed makes a more certain contact upon the inverted tread than the shoe now in use on the third-rail conductor surface contact. The shoe does not jump during any speed, and at sections where the shoe passes from one third rail section to another provisions are made for easy mesh of shoe with the rail, if the motorman does not remove the shoe as is provided.

This system of third rail can be operated in connection with the overhead system, the electric trains, or cars being equipped with both the overhead and the third-rail trolley shoe, which can be instantly removed and placed in a firm position out of the way, and quickly replaced when desired by the motorman, thus enabling electric trains to be run through without delay or stopping of electric car now necessary in changing from one system to another.

The New Woodward Water Wheel Governor.

The governor selected for use in the three-phase power plant of the United States Arsenal at Rock Island, Ill., is a new type of Woodard governor made by the Woodard Governor Company, at Rockford, Ill. This governor, shown in Figs. 1 and 2, is somewhat similar to and operates on the same principle as the friction governor which this company has been manufacturing for thirty years past. In its construction no radical departures have been made from the successful principles of its vertical governors. The new governor is arranged to secure greater simplicity and rigidity and ease of repairs.

Referring to the accompanying illustrations, the power to operate this governor is supplied from the main shaft of the water wheel, which is belted to the large pulley seen in the rear. On the shaft on which this pulley is fixed, there is mounted a compressed paper friction clutch or drive. Supported on the sleeves of this main shaft are two pans, which when pressed against the compressed paper move the gates of the turbine in either direction, by means of double gear connection to an intermediate shaft, which is connected in turn to a turbine gate shaft. The governor balls are separately driven from the main shaft of the water wheel. As the speed changes, the rod of the speeder rises and lowers, causing either one of two tappets to engage with a cam which is revolved continuously

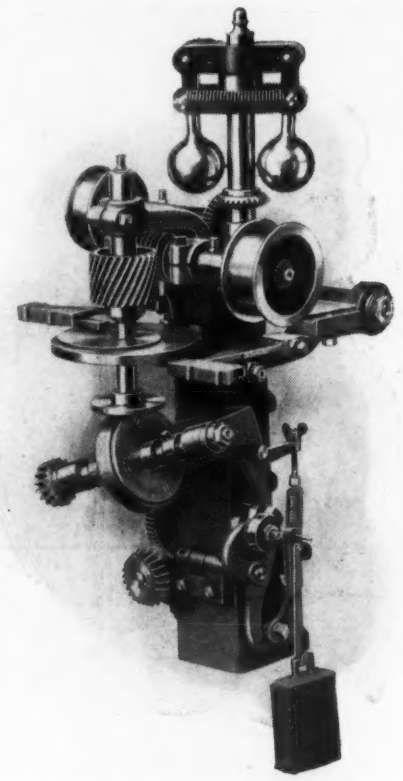


FIG. 1.—WATER WHEEL GOVERNOR.

by means of worm gearing. This cam is driven independently of the governor by a belt from the main shaft of the governor. The motion of the tappets is conveyed through crank shafts to the main shaft and as this shaft is forced back and forth, friction is brought to bear on the opening or closing plan. When the speed is normal, the cam revolves between the upper and lower tappet without engaging either. The cam mechanism is capable of very close adjustment so the governor acts on very small changes of speed, but at the same time it will not act when the speed and load are steady and consequently there is less wear on gate mechanism than with a governor that keeps a gate in continuous motion, although so slight as not to affect the speed. Just below the cam and fastened to the same shaft is a concave disc which rides upon a compensating wheel traveling loosely on an oblique shaft. This oblique shaft is geared to the intermediate shaft so that it travels only when there is a movement of the gates. The object of this is to avoid racing of the governor. When the speed is normal the compensating wheel seeks the center of the disc, which is supported upon it, because this disc is constantly revolving with the cam. When the movement of the gates occurs, the compensating shaft is revolved, and the wheel will travel along its shaft in such a direction that it will disengage the cam from the tappet when the gate has been moved to that point which will give the correct speed after the momentum of the machinery has been overcome. During this interval, the disc will return the compensating wheel to the original position. This device can be designed to properly compensate for any conditions as the time required in regulation can be varied not only by varying the pitch of the screw, but also by varying the speed of the oblique shaft by a change of gears. This compensating mechanism is the same as has proved so satisfactory in the vertical type of governor and, it is said, absolutely prevents racing. The governor illustrated is the largest one made, having friction wheel 24 in. in diameter with sufficient force to transmit if necessary 5,000 foot-pounds per second to the turbine gates. At present three gov-

FIG. 2.—WATER WHEEL GOVERNOR.

ernors are in operation in the Arsenal plant at Rock Island, with a fourth to be installed. These are geared to close the gates from full open in six seconds. The Ottawa & Hull Power & Manufacturing Company, of Quebec, has used one of these governors in its temporary plant for some time and is putting two of them in its large new station. Each governor will control four turbines, operating a 1,500-kw generator. A 1,000-hp turbine under 90 ft. head in Rochester has also been controlled by this type of governor for some time, which shows the class of work it is being used on.

Double Spiral-Filament Lamps.

The accompanying illustrations show some of the forms of double spiral-filament lamps manufactured by the Sterling Electrical Manufacturing Company, Warren, Ohio. This special form of filament, which is successfully utilized in the company's commercial lamps, is employed quite as successfully in the smaller sizes, the demand for it being so great, it is said, that the company is using it in all of its lamps. The range of the small lamps takes in the special

VARIOUS STYLES OF DOUBLE-FILAMENT LAMPS.

shapes for telephone, elevator, signal, dental and surgical work, and in addition to these the company is bringing out a new type of lens lamp.

By the use of this form of filament it is stated that the standard lamps give an intensity of 16 cp from all light-giving points of the bulb, with corresponding results from the smaller sizes.

The company makes, besides its standard commercial lamps, a complete line of battery lamps, miniature series multiple and candelabra lamps, ranging from ½ to 8 cp, and from 2½ to 125 volts.

Universal Ohmmeter and Faradmeter.

Hitherto, portable testing sets for the measurement of resistance and capacity, and for the location of crosses and grounds, have often been complicated, and frequently heavy. There has been a demand for a compact, simple, direct-reading set, by means of which the above-mentioned tests might be made with small expenditure of time and labor. A new set designed to meet this want has just been put on the market by Elmer G. Willyoung, 11 Frankfort Street, New York City. The set, which is called a "Universal Ohmmeter and Faradmeter," is shown in an accompanying cut. Its operation is founded upon the principles of the well-known slide wire bridge and may be explained as follows: In the central portion of the apparatus is a wire, divided for convenience into four sections. These sections are connected in series by means of heavy brass blocks, thus equivalating a single wire of a length of forty inches. This wire is stretched upon a scale graduated in two ways. Above the wire the scale is divided in such a manner as to give the value of an unknown resistance or capacity directly in ohms or microfarads, as the case may be. Below the wire the scale is divided in equal spaces, each of which is 1/1000 the total length of the stretched wire.

At the left of this central portion is a hard rubber block which carries binding posts for the insertion of an unknown resistance, also binding posts for receiving terminals of a telephone or galvanometer, and for the use of an outside battery if desired, although a battery sufficient for all ordinary purposes is contained in the base of the set.

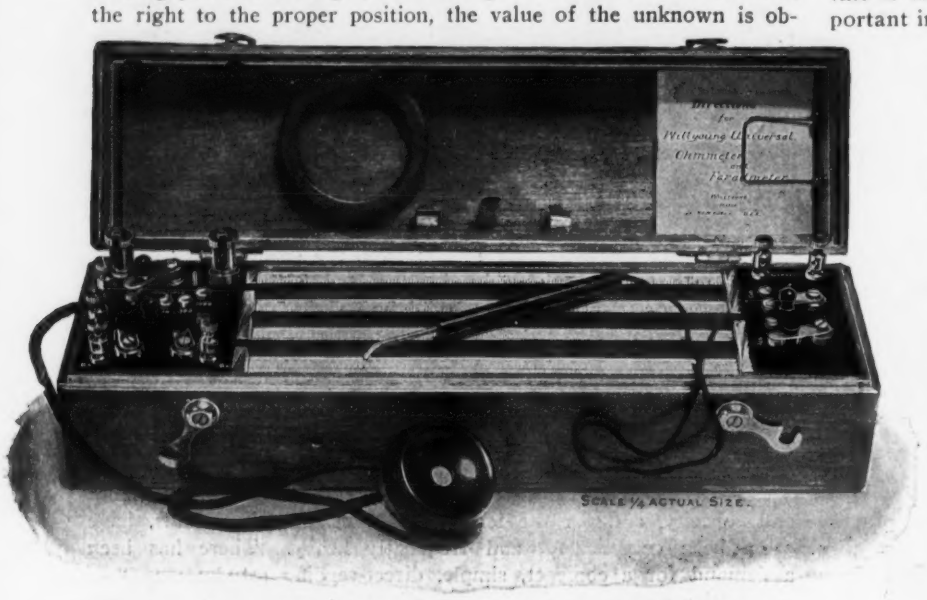
Two switches are also provided on this end of the set. One, shown near the back, controls a variable resistance, which may be inserted as a standard with which to compare the value of an unknown resistance. The other switch, near the front, controls a small induction coil situated in the base of the set. By means of this switch, either a direct or a rapidly alternating current may be employed in making measurements.

At the right is a second hard rubber panel, carrying binding posts for the insertion of an unknown capacity. A double-throw switch

is also shown, which is thrown toward the front for resistance measurements, and toward the back for measurement of capacity.

The simple operation of the set is as follows: Suppose a resistance is to be measured. It is inserted in the binding posts at the left of the set, the rheostat arm being placed at 1, 10, 100 or 1,000, according to the magnitude of the resistance being measured. The telephone is held to the ear, closing the battery key, which is located on the telephone, by pressing a button with the forefinger. The pointer is held in the other hand, and its end touched to one of the four sections of wire. If the double-pole switch at the left of the instrument is toward the right, a continuous buzzing is produced in the telephone when the pointer touches the wire, except at one definite point. When this point is found, the reading of the scale directly underneath this point gives the value of the unknown resistance, if the rheostat be at 1 ohm. If the rheostat be 10, 100 or 1,000 ohms, the reading is to be multiplied by the corresponding value of the rheostat. As this is always a multiple of ten, the operation is exceedingly simple. With the controlling switch in opposite position, a click is produced in the telephone, instead of a buzz, except at the balance point. Results obtained are the same whichever method is used.

In the measurement of capacity, the unknown is inserted in the binding posts at the right, and having moved the switch shown at the right to the proper position, the value of the unknown is obtained in a manner exactly similar to the measurement of resistance. A standard capacity of 1/10 microfarad is contained in the base of the set, so that the reading of the scale directly under the balance point is to be multiplied by 1/10 to obtain the value of the unknown capacity.



OHMMETER AND FARADMETER.

Grounds and crosses may be located, using the ordinary loop tests, the circuit under test being connected as for the measurement of resistance. Open wires in a cable may be located by a measurement of the electrostatic capacity of the broken wire.

The use of an induction coil, giving an alternating current in the secondary, allows determinations to be made of the resistance of electrolytes. The electrolyte under test is held in a glass tube, provided with platinum electrodes. Connection is made to the set exactly the same as in the case of ordinary resistances.

A battery of four powerful dry cells is contained in the base of the set. This battery is controlled by a key located upon the telephone case, as already described. When not in use this key opens automatically the battery circuit. The telephone terminals may be removed, and any sensitive galvanometer may be substituted therefor, if desired, while any outside battery may be connected to the set if deemed necessary.

The induction coil provided is of special design, and free from liability to stick or to give trouble in any way. In case adjustment should be necessary a screw driver may be inserted through a hole in the side of the case, provided for this purpose.

The set is put up in polished mahogany case, provided with hinged cover, with patent clasps, and carrying handle. The complete set weighs only six pounds and measures 16¾ in. x 5 in. x 4½ in.

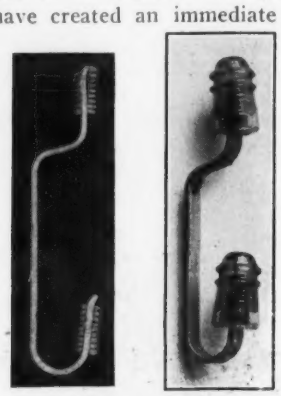
A set similar to the above is also made, but without the portion at the right, i. e., without the portion necessary for capacity tests. Otherwise the instrument is exactly the same and will make all resistance and loop tests. This latter set is called the Willyoung Universal Ohmmeter, and measures 14¼ in. x 5 in. x 4½ in., and weighs only five pounds.

When not in use the telephone and pointer are securely clamped on the inside of the cover of the case, but may be instantly removed when needed for service.

The instrument should be appreciated by everyone connected with the installation and maintenance of cables and aerial lines, the testing of field coils and armatures in dynamos and motors and any work where resistances and capacities are to be quickly and accurately measured. Resistances up to 200,000 ohms and capacities as high as 20 microfarads may easily be measured.

Improvements in Insulator Brackets and Fastenings

It is perhaps too frequently thought that some of our present methods of line construction are the result of so many years of experience that but little improvement is possible. How untrue this is has been recently shown by some very decided and important improvements that the Chicago Telephone Company has been availing itself of with a great resultant saving in the labor connected with certain details of line construction, as well as greater reliability of the work when finished. These improvements were devised by C. L. Peirce, Jr., formerly of the construction department of that company. Mr. Peirce is now introducing these devices for use on all kinds of electric line work and their merits have created an immediate demand for them wherever shown.



FIGS. 1, 2 AND 3.—INSULATOR BRACKETS.

The first device on this list of improvements is a simple, cheap form of forged iron pin and bracket, which is considerably cheaper than malleable cast iron and is not so likely to break the glass insulator screwed upon it. This consists simply of a piece of bar iron, galvanized and bent to the desired shape and having a slight bend on the tip (Fig. 1). Over this flat iron bracket, when an insulator is to be screwed on, is placed a split pin of wood with threads turned upon it. This wood is like the threaded part of an ordinary wood pin-sawed in two longitudinally. Before the insulator is screwed on, the wood split pin is in the position shown at the bottom in Fig. 1. As the insulator is screwed on, it draws these wooden pieces toward the bent tip of the bracket and wedges one half against the bent tip, as in the top pin, Fig. 1. The result is a very tightly screwed insulator, Fig. 2, but at the same time it is one that has the benefit of wood cushioning. This form of pin is covered by broad patent claims.

FIG. 4.—HAMMER DRILL.

The pins can be bent into any form of bracket, being simply bar iron, galvanized. They can be bolted to a wall or pole or to metal cross arms or distributing rings.

Having devised a more satisfactory form of bracket than the ordinary wood or malleable iron casting, the next step was to improve on the usual methods of fastening brackets to brick walls. Many expansion bolts have been devised, the principal objections to which have been the cost and multiplicity of parts. The Peirce expansion bolt, Fig. 3, consists simply of a galvanized bolt with tapered head and a lead washer made by cutting

off a short section of lead pipe. The lead washer is tamped in around the bolt. A special tool has been devised for putting these bolts rapidly in a brick wall. This is shown in Fig. 4. The handle slides back and forth on the stock of the drill so as to give a hammer blow after the manner of a nail puller. The drill is turned slightly after each blow by hand. A hole deep enough for a bolt can be put in a brick wall in ten seconds. The bolt is put in the hole head first, and the lead washer slipped over the bolt. The lead washer is firmly driven and tamped into the hole in the space around the bolt by a hollow tool on the opposite end of the tool stock from the drill. A bolt can be put in a brick wall in twenty seconds, as against about as many minutes where a wooden plug is used in the old-fashioned manner. It was thought at first that the lead might slip out of the hole—unless the hole were made larger in diameter at the bottom than at the surface, but it was found that this is an unnecessary refinement, as the bolts will hold until they break off or until the brick pulls out of the wall, with a hole the same diameter throughout. The Chicago Telephone Company is using about 10,000 per month of the brackets described together with the new expansion bolts for brick walls, and it is finding a rapid introduction among other telephone and electric light companies. These devices are now made by C. L. Peirce, at Chicago.

The International Telephone Transmitter.

A new and interesting form of telephone transmitter is that now being put upon the market by the International Telephone Manufacturing Company, of Chicago. The accompanying cuts show an exterior view and an interior rear view of this instrument.

The case is a little less than three inches in diameter and is properly proportioned and neat in design. The front is a heavy, nickel-plated brass casting on which are rigidly mounted all the working parts. The diaphragm is a flat metal disc and is provided with a rubber band around its edge to perfectly insulate it from the frame. The diaphragm is firmly clamped by two fork-shaped springs holding it evenly at four points, to leave the diaphragm with the greatest possible freedom for vibrating.

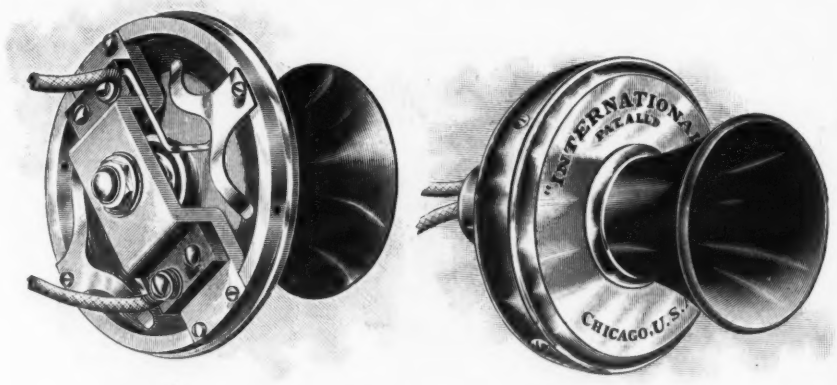
The carbon chamber is a very light metal cup mounted on the center of the diaphragm. The front electrode is spun into the bottom of the cup to leave no room for the granules to settle under its edge. The back electrode is mounted on a brass stud, which is provided with a washer and nut, to firmly clamp a mica ring. The outside of the mica ring is clamped by the rim of the light metal carbon chamber sealing the chamber perfectly.

The back electrode stud is set into a clamping device that is made in the form of a spring collet, allowing the electrode to be moved the slightest degree for adjusting, so that it can be firmly clamped without disturbing the adjustment.

This adjustment clamping deyice is so arranged that it holds the electrode perfectly central with the diaphragm and obviates any indentation or side strain, which usually occurs from the side set screw. The adjusting device is set into a heavy, squarely-formed brass bridge from which it is properly insulated with hard rubber bushing and mica insulation. It is constructed very rigidly to avoid all possibility of throwing the instrument out of adjustment from heavy strains.

The circuit from the front electrode is taken from the diaphragm to an insulated block mounted on one side of the bridge and the circuit from the back electrode is taken from the back electrode stud to an insulated block on the other side of the bridge. These conductors are of light metal punchings, properly formed to make rigid and durable connections without being required to solder any joints of delicate wires. Both sides of the circuit are taken from the two terminals by insulated cord, through the arm to the terminal or induction coil, avoiding the use of any exposed parts of the transmitter frame or arm for any part of the circuit.

Every detail part of this instrument is made by a special compound sub-die to make all like parts absolutely uniform, and so that the instrument can be assembled without filing any part for fitting it. Any part becoming accidentally broken at any time can be readily replaced without returning the entire transmitter to the factory. The electrodes are of extra hard carbon, highly polished, and the granules are clean, hard granular carbon. The diaphragm is placed under the proper tension and the cup vibrates with the diaphragm, which keeps the granules agitated and live at all times, which is said to absolutely prevent "packing" or the instrument becoming out of order.



FIGS. 1 AND 2.—TELEPHONE TRANSMITTER.

"Provo" Insulator.

In the insulator shown in the accompanying illustration the pin is surrounded by an insulating sleeve, which affords considerable additional insulation to the total, inasmuch as it keeps the pin dry and clean. This sleeve, however, is adapted only for a treated wooden pin, since with a pin of metal or other conducting material a high-tension current would bridge the space between the sleeve and pin.

INSULATOR.

Insulators of this construction have been in service on the Missouri River Power Company's transmission system a sufficient length of time to prove them to be satisfactory and reliable, and they are recommended by the manufacturer, the Hemingray Glass Co., Covington, Ky., for pressures ranging from 55,000 to 60,000 volts.

These insulators are 6½ in. high and 8½ in. diameter, and weigh 8 lb. 4 oz. each.

Combined Fan Guard and Deflector.

A notable improvement in connection with electric fans is being placed on the market by the Coleman Mfg. Co., 71 Cortlandt Street, New York. This consists of an arrangement whereby by means of a simple attachment to the guard, the current of air from the fan proper is successively directed through an angle which may be varied from 50 to 140 degrees.

Referring to the accompanying figures, and particularly to Fig. 2, it will be seen that a belt from the fan shaft drives a worm, which in turn gives motion to a worm wheel. A connecting rod

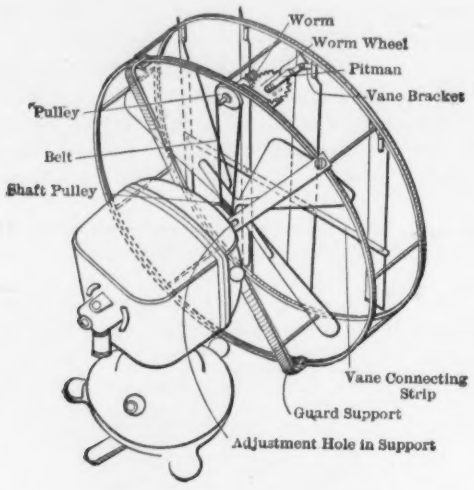


FIG. 1.—FAN GUARD AND DEFLECTOR.

pivoted to the latter gives a reciprocating motion to an arm rigidly connected to one of several vertical pivoted vanes, which motion is transferred to the other vanes by means of a rod or pitman loosely pivoted to each.

The driving belt is a 1-16 in. rubber band. To change the angle of deflection it is merely necessary to readjust the connecting rod, which can be done with a screw driver. To change the rate of deflection, another pulley can be substituted on the worm gear. The guard is standardized to fit any of the ordinary makes of fans, to which it can be attached by any user. It is

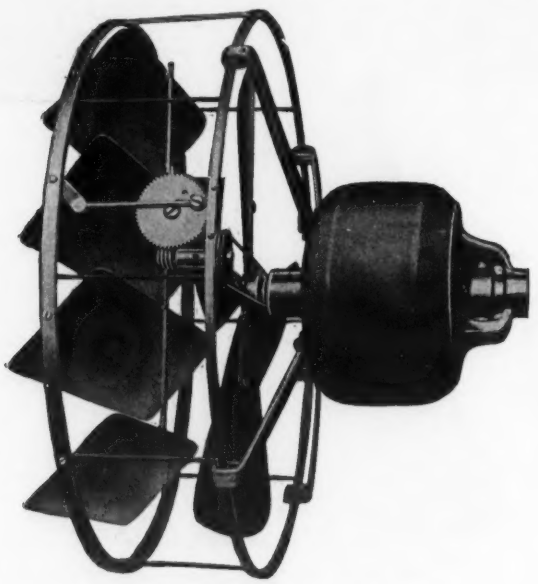
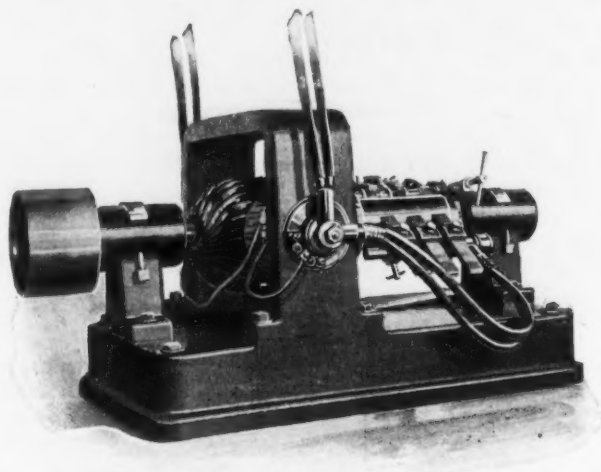


FIG. 2.—FAN GUARD AND DEFLECTOR.

merely necessary to take off the old guard, then the fan, slip a small pulley on the shaft, replace the fan and attach the combined guard and deflector.

A New Electrolytic Generator.

The rapidly increasing demand for low-voltage, heavy-current generators for plating, electrotyping and other varieties of electro deposition has led to the production of a line of machines designed to meet the severe requirements of modern service, one of the smaller sizes (of about 500 amperes) being shown in the accompanying cut. This line, which is now being put on the market by Charles J. Bogue, 213 Center Street, New York, is one of the most recent designed from start to finish solely with reference to the ability to produce rapid and heavy deposits, and to operate continuously. They are designed on a very ample scale and are all guaranteed to their rated load 24 hours a day without overheating or showing any of the ordinary symptoms of overload.



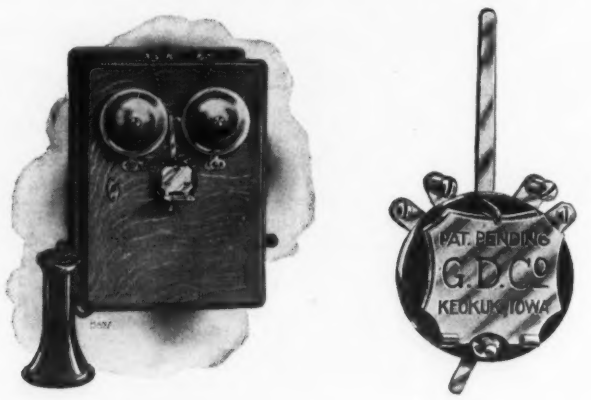
GENERATOR FOR ELECTRO-PLATING.

Their general appearance is perhaps familiar, but a careful redistribution of material has resulted in a "watt per pound" output in advance of previous results.

The machines are well built mechanically and are reliable in operation. They have been produced under the supervision of an engineer having an intimate acquaintance, extending over a long period, with the practical requirements of electroplating and electrotyping in all its branches and are a worthy addition to the well-known apparatus now made by Mr. Bogue.

Telephone Extension Closer.

A new model telephone extension closer for ringing a battery call bell is illustrated in cuts herewith, Fig. 1 showing the simplicity of the device and Fig. 2 showing it attached to the ordinary tele-



FIGS. 1 AND 2.—EXTENSION CLOSER.

phone magneto. The device is mounted on an electrose base, the metal parts being nickeled. A radical departure is made in employing the movement of the bell clapper, instead of the usual magnets, to release the drop shutter. There is a small switch provided, shown at the bottom of Fig. 1, which may be used to open the extension circuit so that the extension bell will not ring when the shutter falls. This device is known as the G-D Extension Circuit Closer, and is being manufactured by the Garton-Daniels Co., of Keokuk, Ia.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Time money was offered with liberality, the rates at the close being easier at 4½ per cent. for 60 to 90 days and 4¾ a 5 per cent. for 4, 5 and 6 months. The stock market was dull, but showed increased firmness. Speculation, however, was narrow and public interest was very limited. General favorable railway earnings are noted, but the fact that net revenues for November and December suffered on account of the increase of wages and general expenses is an element which investors and the street at large have to take into consideration, there being, however, an idea that the increases in rates which went into effect about January 1 will produce better results as regards the current revenues. Otherwise the market presented few features of interest. The industrials were quiet, but some activity was shown in Amalgamated Copper, which was manipulated against the short interest. The United States Steel stocks were firm, but did not show any decided activity. Of the tractions, Brooklyn Rapid Transit was firm, closing at 67⅜, which is practically unchanged from the last quotation. On the other hand, Metropolitan Street Railway showed weakness and declined 2¼ points on sales of 23,375 shares, the closing price being 136½, which was ½ point better than the lowest figure, the highest being 139¾. Manhattan Elevated closed at 144½, ex-rights, which is a net gain of ¾ of a point. General Electric made a jump of 10 points, closing at 197, 1 point below the highest figure, the lowest quotation being 187½. The sales of this stock aggregated 14,160 shares. Westinghouse common closed at 215½, being a net gain of 1 point, and Western Union at 90, a net gain of ⅝. The Boston market was quiet with somewhat irregular prices, General Electric closing at 9 points higher and American Telephone & Telegraph 1 point lower. Following are the New York closing quotations of February 3:

NEW YORK.

	Jan. 27.	Feb. 3		Jan. 27.	Feb. 3
American Tel. & Cable	86	86	General Electric	191	192⅛
American Tel. & Tel.	162	162	Hudson River Tel.	..	..
American Dist. Tel	37	37	Metropolitan St. Ry.	138½	137¾
Brooklyn Rapid Transit	68	67⅞	N. E. Elec. Veh. Trns.	..	⅜
Commercial Cable.	..	..	N. Y. & N. J. Tel.	161	162
Electric Boat	23	20	N. Y. E. V. T. Co.	10	10
Electric Boat pfd.	30	37	Tel. & Tel. Co. Am	..	..
Electric Lead Reduction	3	3	Western Union Tel.	90	89¾
Electric Vehicle	7⅛	7	Westinghouse com.	215⅛	214
Electric Vehicle pfd.	12⅛	12⅛	Westinghouse pfd.	220*	210

BOSTON.

	Jan. 27.	Feb. 3		Jan. 27.	Feb. 3
American Tel. & Tel	162	161½	Western Tel. & Tel. pfd.	99½*	98
Cumberland Telephone	..	..	Mexican Telephone	2	2¼
Edison Elec. Illum.	*277½	..	New England Telephone	135	137
General Electric	192⅛	..	Westinghouse	107	106
Western Tel. & Tel	24	24	Westinghouse pfd.	108	107

PHILADELPHIA.

	Jan. 27.	Feb. 3		Jan. 27.	Feb. 3
American Railways	..	..	Phila. Traction	98¼	98
Elec. Storage Battery	80½	..	Phila. Electric	8¾	7⅞
Elec. Storage Battery pfd.	..	..	Pa. Electric Vehicle	..	..
Elec. Co. of America.	9¼	9¼	Pa. Electric Vehicle pfd	..	..

CHICAGO.

	Jan. 27.	Feb. 3		Jan. 27.	Feb. 3
Central Union Tel.	..	..	National Carbon pfd.	98	98
Chicago Edison	165	162¼	Northwest Elev. com.	..	..
Chicago City Ry.	228	235	Union Traction	12	9
Chicago Tel. Co.	..	158	Union Traction pfd.	45	40
National Carbon	20	24			

*Asked.

ELECTRIC VEHICLE AFFAIRS.—The activity in the securities of the Electric Vehicle Company is accounted for partly by increased business that has resulted from the company's exhibit at the automobile show and partly by the new revenue accrued from royalties paid by rival concerns for licenses to infringe on some of its different patents. It is estimated that the company received $150,000 new business at the automobile show. With regard to royalties an interesting situation has developed. For a considerable time, says the *Wall Street Journal,* several rival companies have been infringing on a number of important patents held by the Electric Vehicle Company, not only for the manufacture of automobiles but of automobile parts as well. The company took action to protect its patents and in 1901 obtained decisions against the Winton Motor Car Company and the Buffalo Gasoline Motor Company—the former being well known—for alleged infringement. No other important litigation took place, but since then the company has been quietly impressing upon infringing companies the advisability of coming to time, with the result that fully a dozen large automobile manufacturers besides many manufacturers of automobile carts are now paying it handsome royalties. Action is also being taken against importers whose machines infringe on the company's patents and a week ago a suit was brought against Smith & Mabley, of New York City, importers of French and German cars.

CENTRAL UNION TELEPHONE COMPANY.—According to the annual report just out, the net profits of the Central Union (Bell) Telephone Company for the year ended December 31, 1902, were $180,345, or approximately 3.3 per cent. on the present outstanding capital of $5,437,902. President Sabin, in presenting the figures, announced: "Your directors believe that the sum shown as net revenue should, in the interests of conservative management, be credited to line repair and maintenance." The company issued no balance sheet, but the following revenue statement was presented:

REVENUE.

	Dec. 31, 1901.	Dec. 31, 1902.	Increase.
Subscribers' rentals	$1,716,341	$2,041,608	$325,267
Toll revenue	710,011	800,784	90,773
Miscellaneous revenue	158,437	161,325	2,888
Totals	$2,584,789	$3,003,717	$418,928
Expenses:			
For administration, taxes, operating and maintenance	$1,973,501	$2,341,989	$368,488
Operating profits	$611,288	$661,728	$50,440
Less interest, including interest on bonds	386,762	481,383	*94,621
Net profits	$224,526	$180,345	$44,181

* Decrease.

THE AMERICAN DE FOREST WIRELESS TELEGRAPH COMPANY was incorporated on January 5th at Kittery, Me., with a capitalization of $5,000,000, $500,000 of which is preferred cumulative and participative. The company is to operate under the patents of the De Forest Wireless Telegraph Company, throughout the United States and Porto Rico. The following is a list of the directors: Dr. Lee De Forest, Ph. D. Yale, scientific director; A. White, President Greater New York Security Company; Ferdinand W. Peck, capitalist, Chicago, Ill.; Henry Doscher, capitalist, Standard Terra Cotta Company; C. C. Galbraith, manager, Armour & Co.; W. N. Harte, Title Guarantee & Trust Company; M. M. MacRae, Strawbridge & Clothier, Philadelphia, Pa.; Clarence G. Tompkins, Berkshire Electric Company; Dr. Samuel V. Abel.

DIVIDENDS.—The Westinghouse Electric Manufacturing Company has declared the regular quarterly dividend of 1¾ per cent. upon the assenting stock, payable February 16. The American Graphophone Company has declared the regular quarterly dividend of 1¾ per cent. on the preferred stock, payable February 16. The Butte Electric & Power Company has declared a quarterly dividend of 1¼ per cent. on the preferred stock, payable February 2. The New England Telephone & Telegraph Company has declared a regular quarterly dividend of 1½ per cent., payable February 16. The Boston Elevated Railway Company has declared a regular semi-annual dividend of 3 per cent., payable February 16.

BELL TELEPHONE SOUTH.—The Cumberland Telegraph Company is preparing to spend $1,000,000 on improvements and new lines in Louisville. The growth of its business has been wonderful notwithstanding an independent company is now in the field. The Cumberland, which is a Bell property, has 20,000 local subscribers, and is building two new exchanges in the eastern and western districts of the city. It is rapidly extending its lines all over the State and the South.

DETROIT EDISON BONDS.—Spencer Trask & Co. are now offering $1,800,000 of Detroit Edison Company's first mortgage 5 per cent. gold bonds at 104 and accrued interest to date of delivery, figuring out 4¾ per cent. The company's business shows an interest charge for 1903 of only one-half the actual net income for 1902, and 40 per cent. of the estimated net revenue for 1903. The new station of the company will have an initial capacity of 12,000 kw, in turbo-generators.

LOUISVILLE TROLLEY IMPROVEMENT.—The Louisville (Ky.) Railway will spend $1,000,000 this year in building interurban lines and in other improvements. An addition will likely be made to the power house at a cost of $300,000, and about 50 to 100 new and modern cars will be ordered, a part of them being already under construction. The money will be raised by selling new stock at par, in all probability.

CHICAGO TELEPHONE COMPANY.—Note was recently made in this department of the growth of the Chicago (Bell) Telephone Company. According to President Sabin's annual report, just out, earnings of the company for the year were equal to 10.02 per cent. on the present outstanding capital, which, in the course of the year, was increased by $2,332,078. The comparative showing of revenue and expenses follows:

	1901.	1902.
Gross revenue	$3,775,001	$4,570,805
Gross expenses (operation, taxes, maintenance, and reserve for deferred maintenance)	2,691,129	3,368,334
Net earnings	$1,083,872	$1,202,471
Dividends	960,000	1,075,192
Surplus for year	$123,872	$127,278

		Per cent.
Gross increased	$795,804	21.07
Expenses increased	677,205	25.16
Net increased	118,599	19.42

The company has had a prosperous career under Mr. Sabin's management. He is the originator of the nickel telephone and the measured service system, and, owing to these innovations, the number of telephone stations in the last two years has increased from 36,414 to 79,043 at the end of last year.

SOUTHERN NEW ENGLAND TELEPHONE.—The Southern New England Telephone Company's annual report for year ended December 31, 1902, compares as follows with previous year:

	1902.	1901.	Changes.
Gross	$919,556	$813,062	Inc. $106,494
Expenses	746,812	652,755	Inc. 94,057
Net	$172,744	$160,307	Inc. $12,437
Dividends	172,500	161,865	Inc. 10,635
Surplus	$244	Def. $1,558	Inc. $1,802
Total surplus	73,576	73,331	Inc. 245

Instruments outstanding increased 3,546, making a total of 21,110.

Commercial Intelligence.

THE WEEK IN TRADE.—Trade developments in January, according to *Bradstreet's*, confirm the sanguine expectations and predictions made at the beginning of the month. Wholesale and jobbing trade in spring dry goods and other wearing apparel is steadily improving and the business at leading cities East and West is the best ever recorded in that month. Among the industries the activity of the recent past continues unabated. The car shortage probably increases rather than grows better. Smaller than expected movements of grain and lumber to market, of fuel from producing centers to consumers and of general merchandise from wholesalers and jobbers to retailers are reported the country over. Preference is still being given to coal shipments, and some railroads are reported refusing all dead freight outside of fuel. Iron and steel production is at its highest point, despite fuel and car shortages, and prices are higher. Activity in lumber is also noted throughout the entire country. While buyers of domestic iron are rather slow to come forward, foreign supplies sell quite freely. December imports of iron and steel were very large. Copper is strong and shows a steadily advanced tendency. Large sales are rumored. The closing quotations were 12½ a 12⅝c. for Lake, 12⅜ a 12½c. for electrolytic in ingots, wire bars and cakes; 12⅛ a 12¼c. for cathodes and 12¼c. for casting stock. The business failures for the week ending January 29, as reported by *Bradstreet's*, numbered 230 against 253 the week previous, and 303 the corresponding week of last year.

UNITED STATES EXPORT TRADE.—The export trade of the United States has resumed its normal and expansive condition. From the low figure due to the failure of the corn crop last year and the unusual demand at home, the export figures have increased from $88,000,000 in June to $148,000,000 in December, and reached the highest mark ever made by exports in the month of December. June, July and August of the year 1902 were the only months since August, 1899, in which the export figures fell below the $100,000,000 line, and this was due to the causes above indicated. On the import side the figures are equally suggestive of growth. The December imports are larger than in any preceding December in the history of our import trade, being $94,307,204, against $79,929,271 in December, 1901, and $68,697,297 in December, 1900, and larger than in any preceding month except April, 1897, when the imports were abnormally large by reason of the approaching change in tariff. Importations free of duty are $40,663,113 against $29,145,669 in December, 1900, indicating that the increase is chiefly in manufacturers' material, which form the bulk of the nondutiable articles. The total imports for the year ending with December are far in excess of any preceding year, being $969,270,009, against $880,419,910 in 1901, $829,149,714 in 1900, $823,397,726 in 1890, $696,807,176 in 1880, and $461,132,058 in 1870. The importations of 1902 are $88,850,099 greater than in the preceding year, of which increase over $60,000,000 was in manufacturers' materials.

ELECTRICAL EQUIPMENT FOR MALAY SMELTING WORKS.—The Straits Trading Company, of Singapore and Penang, which operates at the latter place the largest smelting works in the old world, has ordered through Bagnall & Hilles, Yokohama, considerable American equipment. An extensive cable system is to be installed. Three endless cables have been ordered from the American Steel Cable Company, of San Francisco, Cal. Two of the cables will each be operated by a similar number of 10-hp motors of General Electric Company's manufacture. The third cable is to be worked by a 25-hp General Electric motor. The works will be operated throughout by electricity. For lighting use, two 25-kw Sprague dynamos will be installed. The engines are to be of Ames make.

ANOTHER MEXICAN WATER POWER PROJECT.—Guillermo Brockman, of the City of Mexico, has been granted a concession by the Mexican authorities for the purpose of constructing hydraulic works to utilize the storm waters of the Tlalpujahua River, located in the districts of Iscthlahuaca and Maravatio, in the States of Mexico and Michoacan, in that part of the river's course comprised between its source and the point called Cruz Blanca. The franchise permits of the water being used either directly for the production of motive power on the spot or for conversion into electric energy and transmission to a distance.

THE ELECTRIC CARRIAGE CALL COMPANY, 1402 Broadway, New York City, have closed through their Washington agent, the National Electric Supply Company, a contract for installing their admirable system at the White House. The matter has been thoroughly investigated and it is found that this is the only means to abolish the confusion and annoyance experienced so often outside the Executive Mansion, at the various receptions there. Inquiries have recently reached the New York offices from Johannesburg, South Africa, showing that business and pleasure are becoming more active in that part of the world.

CONTRACTS PENDING FOR CANADIAN WATER POWER PLANT.—The Rainy River Pulp & Paper Company has secured a water power on Sand Island River, located a few miles north of Mine Centre. The water power has a 16-ft. fall and is estimated to be capable of developing 1,800 hp. The men primarily interested in the undertaking are Hon. Geo. E. Foster and W. J. Elliott, of Toronto; William Blackwood and R. M. Simpson, of Winnipeg, and William A. Preston and Louis Hamel, of Mine Centre. Contracts for equipment, etc., are expected to be let very shortly.

THE OTIS ELEVATOR COMPANY reports the following contracts recently closed: North German Lloyd Steamship Company, Hoboken, N. J., ten electric passenger elevators; Kean Van Cortlandt & Company Building, 28 to 32 Pine Street, four hydraulic elevators; Hotel Willard, Washington, D. C., four hydraulic elevators and two electric elevators, and the Belvidere Hotel, Baltimore, Md., seven plunger elevators with a car travel of 160 feet.

SPANISH ACTIVITY.—The late Spanish-American war seems to have impressed upon the engineers of the Spanish Government the need of adopting the most modern methods in the manufacture of munitions of war. It is installing Westinghouse motors in its gun shops at Trubia, and the arsenal at Ferrol is also shortly to be equipped with a number of motors and other electrical machinery.

PERUVIAN WATER POWER PLANT.—The Empresa Electrica de Santa Rosa, of Lima, Peru, has placed a contract with the Pelton Water Wheel Company, 143 Liberty Street, New York, for two wheels capable of developing 2,000 hp, to be direct-connected to General Electric generators. The Pelton people have also taken a contract for 2,100 feet of 60-inch pipe.

TURBINES FOR VENEZUELA.—Eduardo S. Larralde, an extensive sugar and coffee planter from Caracas, Venezuela, is now in New York for the purpose of purchasing considerable equipment, including some small water turbines. He can be reached care of the Export Club of Mexico, 82 Wall Street.

AMERICAN CONDUIT FOR ST. PETERSBURG.—The American Vitrified Conduit Company, 170 Broadway, will manufacture the major portion of the conduit to be installed in St. Petersburg, Russia, in connection with the new municipal telephone system.

MEXICAN HYDRAULIC PROJECT.—Jose A. Camarena, of the City of Mexico, has been granted a franchise for the purpose of utilizing 1,000 liters of water per second from the River Tenchitlan, located in the State of Jalisco, Mexico.

NORTH EASTERN RAILWAY CONTRACT.—It will interest our readers to know that some of the contracts for the electrification of about 40 miles of one of the Newcastle branch lines of the North Eastern Railway have now been given out. The British Thomson-Houston Company, of Rugby, has been awarded the contract for the permanent way and rolling stock, though the contract for the high-tension cables and the sub-stations has not yet been placed. The work on this railway is all the more interesting, as when completed this will be the first section of an established steam railway to have been converted to electrical operation, the attendant results of which will be most important as foreshadowing the history of all steam railways in the not very far distant future. The British Thomson-Houston Company will most probably use an 80-lb. third rail for the positive side of the circuit, and will bond the joints in the existing track rails for the return circuits. Under this contract are included all the low-tension cables required to connect the bus-bars of the sub-station with the third rail along the track and all switching devices, sectionalizing pillars, etc. The contract for the rolling stock consists of the electrical equipment of 50 motor cars and 50 trail cars. Each motor car equipment will consist of 2 G. E. 66 motors, 1 C. P. 14 air compressor, 1 complete equipment of the British Thomson-Houston master train control. This apparatus is somewhat similar to that which the British Thomson-Houston Company have supplied for the Central London Railway and the Great Northern & City Railway. They are also supplying one motor truck and one trailer truck for each of the motor cars, and the contract includes two complete electric locomotives, with 40 tons weight on the drivers. Each of these locomotives will be equipped with four G. E. 55 motors, and one C. P. air compressor, and complete master train control equipment, similar to that used on the motor cars. The entire air brake gear for the locomotives will also be supplied by the British Thomson-Houston Company. The lines at Newcastle of the North Eastern Railway to be equipped consist of two miles of four-track line, about 35 miles of double-track line, and 5 miles of single-track line, including the sidings, etc. For the operation of the system power will be taken from the Newcastle Electric Supply Company.

EXPORTS OF ELECTRICAL MATERIALS.—The following are the exports of electrical materials and machinery from the port of New York for the week just ended: Antwerp—25 pkgs. material, $1,375. Argentine Republic—175 pkgs. material, $4,915. Arnheim—1 pkg. machinery, $20. British Guiana—12 pkgs. material, $783. British Australia—49 pkgs. machinery, $5,000. British Possessions in Africa—30 pkgs. material, $1,502. British West Indies—8 pkgs. material, $94. Barcelona—3 pkgs. machinery, $203; 18 pkgs. material, $500. Bristol—75 pkgs. machinery, $5,100. Berlin—2 pkgs. machinery, $125; 5 pkgs. material, $500. Copenhagen—17 pkgs. machinery, $1,520. Cadiz—3 pkgs. machinery, $600. Chili—11 pkgs. material, $759. Colombia—42 pkgs. material, $339. Cuba—50 pkgs. material, $915. Central America—26 pkgs. material, $536. Dutch West Indies—9 pkgs. material, $91. Egypt—45 pkgs. material, $688. Genoa—1 pkg. machinery, $40; 1 pkg. material, $50. Hamburg—69 pkgs. material, $2,954. Havre—25 pkgs. material, $1,270; 2 pkgs. machinery, $20. London—16 pkgs. machinery, $1,095; 159 pkgs. material, $8,451. Liverpool—518 pkgs. machinery, $11,569; 49 pkgs. material, $1,840. Lisbon—7 pkgs. material, $104. Mexico—47 pkgs. material, $1,062; 2 pkgs. machinery, $300. Manchester—5 pkgs. machinery, $2,581. Newfoundland—2 pkgs. material, $32. Naples—1 pkg. material, $75. Newcastle—8 pkgs. machinery, $915. Peru—9 pkgs. machinery, $211. Rotterdam—24 pkgs. machinery, $906. Stockholm—1 pkg. material, $795. San Domingo—3 pkgs. material, $34. Northampton—138 pkgs. material $986; 2 pkgs. machinery, $200. Trieste—2 pkgs. machinery, $100. Uruguay—9 pkgs. machinery, $611. Vienna—1 pkg. machinery, $60.

THE RONEY MECHANICAL STOKER maintains its popularity as an important factor in steam plant operation. A few recent stoker orders comprise: North Jersey Street Railway Company and Jersey City, Hoboken & Paterson Street Railway Company, 12 quadruplex stokers for plant extensions aggregating 6,250 hp; Indianapolis Street Railway Company, 12 duplex and quadruplex stokers for 4,200-hp B. & W. and Zell boilers; Indiana, Lebanon & Frankfort Railway, 12 duplex stokers for 3,000-hp plant of Stirling boilers; Utah Light & Power Company, Salt Lake City, 6 duplex stokers for a lighting plant containing 1,250-hp Heine boilers; Phœnix Iron Company, 6 quadruplex stokers, for rolling mill plant, fifth order, 2,700-hp extension, Heine boilers; Schlitz Brewing Company, Milwaukee, 4 duplex stokers for plant extension, 600-hp horizontal return tubular boilers; Youngstown (Ohio) Consolidated Gas & Electric Company, third order, quadruplex stokers for central lighting, railway and power plant, 1,050-hp B. & W. boilers; American Locomotive Works, Schenectady, central power station, fifth order, 700-hp Heine boilers, quadruplex stokers; Carnegie Steel Company, sixth order, 500-hp Aultman-Taylor horizontal boilers for pumping station, duplex stokers; Rhode Island & Suburban Railway, plant extensions, quadruplex stokers, 1,050-hp B. & W. boilers, 12,000 hp ultimate; Pennsylvania Railroad, Altoona, Juniata Shops, quadruplex stokers for Sederholm boilers; Pressed Steel Car Company, seventh order, duplex stokers, Aultman-Taylor horizontal boilers, 1,000 hp, new power plant; Hartford Carpet Corporation, Thompsonville, Conn., new plant, 760-hp Aultman-Taylor horizontal boilers, quadruplex stokers.

ELECTRICAL SUPPLIES FOR ABROAD.—The Manhattan Electrical Supply Company, 32 Cortlandt Street, New York, has lately taken some substantial orders for its various specialties for shipment to South American countries and China, the orders for the latter country having come principally through Wilhelmi & Co., 116 Broad Street. The Guanajuato Power & Electric Company, which is to build a 5,000-hp water power plant on the River Duero to generate energy for transmission to the city of Guanajuato, Mexico, 110 miles distant, has placed a contract with the Manhattan people for a large lot of construction material. Domestic orders recently secured include substantial ones for dry-cell batteries for telephone systems. The New York department stores have also been ordering quite a quantity of medical batteries lately.

MORE AMERICAN EQUIPMENT FOR DURBAN ROAD.—The British electrical engineering and contracting firm of Macartney, McElroy & Company, through its New York offices in the Havemeyer Building, has let contracts for further American equipment for the Durban (South Africa) municipal electric traction system. Some 35-hp double motor equipments have been ordered from the General Electric Company. The J. G. Brill Company, of Philadelphia, has been allotted another order for trucks. Two hundred and fifty car seats have also been contracted for. The Heywood Brothers & Wakefield Company, of 129-135 Charlton Street, New York, and Hale & Kitchin, of Philadelphia, Pa., got the orders. Two compressors for use in connection with the power house are about to be ordered.

MINING CONTRACT FOR MEXICO.—The Terrenates Consolidated Mining Company, of Parral, Mexico, has contracted with the Denver Engineering Works, of Denver, Colo., for the installation of a complete plant for the transmission of 600 hp, to be used for the operation of hoisting and pumping machinery, in the celebrated Terrenates mines of the company. De Laval steam turbine generators will furnish the current, which is conveyed about one and one-half miles by aluminum conductors to the hoists and pumping stations. The work will all be under the direction of Mr. Frank B. Rae, 52 Broadway, New York, consulting engineer for the Terrenates Company.

CONTRACTS PENDING FOR MEXICO.—The Compania Tabasquena Electro-Motriz Sociedad Anonima—the Tabasco Electro-Motor Company, Limited—has just been organized in San Juan Bautista for the purpose of furnishing current to light that Mexican city, which has a population of about 10,000. The charter was granted by the municipal authorities to Senor Manuel Gabricio. The capital of the concern is $150,000. The directors are Gonzalo Ramos Alfonso Jose Bulnes Tavares, Jose Gonzales Lamadrid, Jose Bulnes Villavicencio and the concessionaire, all located in San Juan Bautista. Contracts for equipment, etc., will be let very shortly. It is expected that the plant will be completed May next.

A RUBBER-ASBESTOS CABLE CODE.—The International Cable Directory Company, at the request of manufacturers and dealers in rubber, asbestos, packing, belting, etc., has compiled and published a supplement to the Western Union Telegraphic Code, intended for the use of those engaged in these branches of industry. Every known technical term used in the different lines is embodied in the book. The book comprises 200 pages and 25,000 terms and phrases, and contains a list of the leading rubber manufacturers and dealers, together with their registered cable addresses and code words to represent the titles of the companies and firms.

THE NORDEN-BITTNER ELECTRIC COMPANY has been awarded the contract for the electrical display and decoration for the Arion ball, which is to be held at Madison Square Garden February 6, 1903, by Mr. F. Hildebrandt, chairman of the Decorative Committee of the Arion Society. The Norden-Bittner Electric Company is the inventor of the Norbitt specialties, as manufactured by the Crouse-Hinds Electric Company, which is the sole manufacturer and licensee.

RUSSELL ENGINES FOR JAPAN.—The Russell Engine Company, of Massillon, Ohio, is about to make a shipment of engines to Japan for a Yokohama electric lighting plant. The order was secured through Bagnall & Hilles, Yokohama, whose Mr. Hilles is still visiting the United States, and may be found at the offices, 114 Liberty Street, of the New York Insulated Wire Company.

ORDERS FOR BALL ENGINES.—The Detroit Iron & Steel Company, Detroit, Mich., is installing three 350-hp horizontal direct-connected units. The Ball Engine Company, Erie, Pa., furnish the engines. The Charles City Lighting & Heating Company, of Charles City, Iowa, is about to install two direct-connected units of 600 hp capacity. The Ball Engine Company will build the engines.

General News.

THE TELEPHONE.

LOS GATOS, CALIF.—The Saratoga Mutual Telephone Company has been organized here. R. A. Husted is president and J. T. Richards secretary and treasurer. The company will begin construction work at once.

WASHINGTON, D. C.—The Chesapeake & Potomac Telephone Company, of Washington, has awarded to Richardson & Burgess, of this city, the contract for the erection of a new telephone building on Twelfth St., between G and H Sts. Rapid progress is being made in placing all wires underground in the northwestern section of the city. About 200 poles and 800 miles of overhead wire are to come down.

LAKE CITY, FLA.—The Whetstone Telephone Company has been incorporated by L. F. Whetstone, R. W. Adams and others. Capital $10,000.

FORT MYERS, FLA.—The Indian River Telephone Company, with a capital of $5,000, has been incorporated by W. H. Harris, Geo. E. Coon and others.

BELVIDERE, ILL.—The Belvidere Independent Telephone Company is about to build a toll line to connect with the new independent system at Rockford, thus giving subscribers connection with numerous points in northern Illinois. During the past year, the local company has installed 10,000 feet of cable and built 16 miles of toll line. It now has 700 subscribers, at rates of $12 and $24.

VERNON, IND.—The stockholders of the Naylor & Vernon Telephone Company have organized by the election of the following officers: President, W. R. Naylor; secretary, C. L. King; treasurer, M. Crosby.

BETHEL, IA.—A telephone company has been organized in Post township. E. Swenson is president.

GARNER, IA.—The Hancock County Rural Telephone Company has been incorporated by Thos. Duff, C. M. Gowdy and others.

GEORGETOWN, KY.—The exchange room of the Georgetown Telephone Company was wrecked by an explosion recently. A box containing dynamite for blasting post holes had been left in the office. Several of the operators were injured.

SPRINGFIELD, MASS.—A number of business men from Springfield have visited and examined the automatic exchange system at Fall River. The mayor was one of the party which went under the guidance of Dean & Shibley, of Providence, who may finance the Hampden Automatic Telephone Company, of Springfield. A very favorable opinion seems to have been formed of the working of the system.

ST. PAUL, MINN.—The Star Telephone Company of New Market, Scott County, has been incorporated with a capital of $50,000. The incorporators are P. J. Welter and J. N. Sanford, of New Market, and Henry Sprain, of Webster.

JACKSON,MISS.—The Rural Telephone & Telegraph Company, of Panola County, has been incorporated with a capital stock of $5,000.

NATCHEZ, MISS.—A franchise has been granted the Cumberland Telephone Company in Natchez, Miss., on condition that several long distance connections shall be built and that present rates shall not be increased.

PRINCETON, N. J.—The Automatic Telephone Company, of Princeton, N. J., is installing its new automatic switchboard of 1,000 capacity and 150 telephones installed, which it recently purchased from the Automatic Electric Company, of Chicago. A number of years ago the Princeton Company entered the telephone field with an automatic switchboard and fifteen stations connected up. The service grew in public favor until the ultimate capacity of the board, which was 100 stations, was exhausted, at which time the management gave the manufacturers an order for an entirely new outfit.

SCHENECTADY, N. Y.—The Home Telephone Company has begun its service and has 275 telephones connected up.

KINGSTON, N. Y.—The Deep Notch Telephone Company, of Kingston, has increased its capital stock from $500 to $5,000.

ELMIRA, N. Y.—The York State Telephone Company, which recently bought the Binghamton Telephone Company's plant, has elected officers for the ensuing year as follows: President, W. D. Barnard, Philadelphia; vice-president, Edward Davis, Philadelphia; secretary and treasurer, Robert M. Dougal, Philadelphia; directors: S. L. Johns, McSherrytown, Pa.; Boyd McDowell, Elmira; Ward R. Bliss, Chester, Pa.; W. D. Barnard, St. Davids, Pa.; Ellis L. Orvis, Bellefonte, Pa.; R. G. Parke, Philadelphia; Meade D. Detweiler, Harrisburg, Pa.; T. B. Crary, Binghamton; H. H. Light, Lebanon, Pa.; Eli S. Rheinhold, Mahanoy City, Pa.; E. M. Yarnell, Philadelphia; C. M. Clement, Sunbury, Pa.; Edward Davies, Philadelphia; G. R. Van Allen, Northumberland, Pa.; E. M. Leader, Shamokin, Pa.; W. A. Thompson, Coatesville, Pa.; S. P. Light, Lebanon, Pa.; Eugene Diven, Elmira. Directors of the Elmira Telephone Company were re-elected.

REIDSVILLE, N. C.—The stockholders of the Reidsville Telephone Company have elected G. D. Williams, president. A 10 per cent dividend was declared.

ASHEVILLE, N. C.—According to a recent report it is probable that the Asheville Telephone Company holds the world's record for the percentage of subscribers as compared with the population, there being one subscriber to every thirteen inhabitants.

BLOOMDALE, OHIO.—Claude Wygandt, of Toledo, has been granted a telephone franchise in this place.

DEFIANCE, OHIO.—The Northwestern Toll Line Company has increased its capital stock from $20,000 to $50,000.

McCOURT, OHIO.—The Council has granted a franchise to M. Cotterman, of Deshler, for a telephone exchange in this place.

BARBERTON, OHIO.—The Farmer's Telephone Company will build a line into Barberton to connect with the local exchange.

MECHANICSBURG, OHIO.—The Mechanicsburg Telephone Company has increased its capital stock from $25,000 to $35,000

WAYNESFIELD, OHIO.—The Auglaize Telephone Company has increased its capital stock from $5,000 to $15,000. Harper Stiles is president.

BUCYRUS, OHIO.—Arrangements have been perfected by the Bucyrus Telephone Company for the construction of a new rural line on the Wyandot road.

MARION, OHIO.—The United States Telephone Company (long distance) is building a toll line from Marion to Bucyrus, connecting the exchanges in both places.

NORWALK, OHIO.—A number of prominent business men have formed an association and decided to use only one telephone system. The company that offers the best terms and service will get the contracts of all.

WAPAKONETA, OHIO.—The Minster Home Telephone Company has opened for business with about 70 telephones. The Minster exchange has complete connection with the different independent exchanges in this part of the country.

BELLEVUE, OHIO.—The Flat Rock Telephone Company has elected these officers: C. C. Pfund, president; E. F. Leinhard, vice-president; W. H. Gardner, treasurer; T. E. Wyant, secretary, and S. D. Huff, general manager.

MARTIN'S FERRY, OHIO.—The Belmont Telephone Company has elected the following named directors: J. C. Dent, J. B. Driggs, J. C. Heinlein, A. J. Heinlein, C. L. Weems, E. G. Smith, Henry Schulback and J. W. Doudna.

FITCHVILLE, OHIO.—The Clinton Line Telephone Company has been organized and will install a farmer's community system. Connection will be made with the exchange at New London. E. K. Jennings is president of the company.

OTTAWA, OHIO.—The Farmers' Mutual Telephone Company and the Ottawa County Home Telephone Company are preparing to install systems in the town under the provisions of franchises recently granted. It is the plan to consolidate the exchanges in that vicinity.

WESTON, OHIO.—The Weston Home Telephone Company has reorganized with the following named officers: D. E. Lashley, president; G. B. Spencer, treasurer. The above, with George Potter, Howard Kline, W. A. Dewese, S. A. Murphy and Milton Dunbridge, are directors.

AKRON, OHIO.—The Akron People's Telephone Company has elected these directors for another year: Will Christy, J. R. Nutt, H. C. Lang, C. W. DeVoe, R. M. Pillmore, P. R. Iredale. The report of the secretary indicates that the company gained 602 telephones during the past year.

RAVENNA, OHIO.—The Ravenna Home Telephone Company has elected the following named directors: President E. R. Taylor; secretary, H. L. Beatty; treasurer, W. S. Krake, W. W. Stevens, C. H. Pitkin, C. C. Byers, J. F. Babcock. The company is planning to enlarge its exchange.

WESTON, OHIO.—The Standard Telephone Company, capital $100,000, has been incorporated by W. D. Mudge, Azor Thurston, Merton Bamer, Sumner Cottingham and others. The company has absorbed exchanges at Weston, Grand Rapids and Deshler. It will extend its lines throughout Ottawa, Lucas, Seneca, Putnam, Paulding, Fulton, Defiance, Henry and Williams counties.

WAPAKONETA, OHIO.—The Peninsula Telephone Company, which is building an exchange at Tampa, Fla., is planning for the construction of exchanges in several other towns in that State. Senator W. G. Brorein, J. H. Cooke, Guy Hoffman and S. A. Hoskins, of this city, are at the head of the company.

DELAWARE, OHIO.—The Delaware Citizens' Telephone Company has elected the following named officers: W. M. Heseltine, president; W. G. Hormell, vice-president; G. H. Carter, secretary, and F. P. Hills, treasurer. The above, with C. D. Young, W. G. Jones and W. B. Hedges, are directors. The company has increased its capital stock from $60,000 to $100,000, and is planning a number of extensions and improvements.

PITTSBURG, PA.—A new independent telephone company, backed by Eastern capital, is to tap Pittsburg and erect a network of lines in adjoining counties of Western Pennsylvania and a trunk line to the East. The company will soon be chartered in Pennsylvania as the Union Telephone and Telegraph Company, with a capital of $3,000,000.

VIBORG, S. D.—The Viborg and Centerpoint Telephone Company has been incorporated with a capital of $10,000. M. V. Olsen is president and F. L. Larson secretary. It is their intention to build a line to Centerpoint from Viborg and also to run rural lines in all directions from these two places.

MEMPHIS, TENN.—The Memphis Telephone Company will expend between $200,000 and $400,000 in new lines in the territory tributary to Memphis.

MANCHESTER, VA.—Negotiations are on foot for a consolidation of the Southside Telephone Company, of Manchester, and Chesterfield, Va., with the Southern Bell Company.

RICHMOND, VA.—An important bill has been introduced in the State Legislature to require telephone companies to connect with other telephone lines and to transmit messages originating on other lines at the same rates charged their own subscribers. The bill if enacted will give small independent lines connection with the Bell Company's lines and will enforce telephone cooperation. The bill will be strongly opposed.

MILWAUKEE, WIS.—The Wisconsin Telephone Company will expend $650,000 in building lines in the Superior district.

MADISON, WIS.—The Platteville, Rewey & Ellenboro Telephone Company has changed its headquarters from the town of Lima to Platteville.

MILWAUKEE, WIS.—The Badger State Telephone & Telegraph Company has been organized, with a capital of $100,000, to succeed the Badger State Long Distance Telephone Company. The promoters are H. A. Upham, D. H. Van Dyke, Chas. C. Russell and J. R. Fish, of Milwaukee, and Richard Valentine, of Janesville.

ELECTRIC LIGHT AND POWER.

HUNTSVILLE, ALA.—The election for issuing $20,000 bonds for an electric light plant at Huntsville has been carried.

BRUNSWICK, GA.—At a meeting of the Electric and Water Company, of Brunswick, it was decided to issue $250,000 25-year 4 per cent. bonds.

CARTERSVILLE, GA.—Plans have been practically completed for the development of power in the Etowah river, at Cartersville, by the Etowah Power Company in connection with the estblishment of a $1,500,000 cement plant by Chicago capitalists. W. E. Dorwin, president of the Portland Cement Company, proposes to erect the latter plant.

KINMUNDY, ILL.—There is talk of the city electric light plant being shut down on account of the high price of coal. At the present price the receipts at the plant will not pay the coal bill.

CAIRO, ILL.—The Cairo Electric Light and Power Company has secured an option on the plant of the Egypt Electric Company. The price agreed upon is in the neighborhood of $40,000. The Egypt Company operates the original street car line here, besides furnishing light and power. The new owners are the Holliday interests, Maj. E. W. Holliday being at the head of the Cairo Electric Company. By this deal the entire street car system of the city, as well as the entire electric lighting, will be under one management. It is rumored that one result of the consolidation will be the construction of an electric railway connecting Cairo with Mound City, Mounds and Villa Ridge.

FORT DODGE, IA.—The Fort Dodge Light and Power Company is to expend from $275,000 to $300,000 in improving its plant in this city. Work is to be commenced at once. The plans of the company contemplate the extension of its street car line and the operation of many additional cars, the entire rebuilding of the present gas house and the equipment of the electric light plant with new machinery and generators.

BOSTON, MASS.—A majority interest in the Milton Light & Power Company, the Dedham Electric Company and the Blue Hill Electric Company has been purchased by a syndicate headed by C. L. Edgar in the interest of the Edison Electric Illuminating Company of Boston. The syndicate will immediately proceed to dismantle the plants of all three companies, removing boilers, generators, etc., and making the power-houses distributing points for the power which will be supplied by the Edison Company from Boston.

MONROE, MICH.—The municipal electric lighting plant has been closed for an indefinite period owing to the inability to secure fuel.

MONROE, MICH.—The council has been asked for a franchise for a steam heating and electric lighting system. Toledo people are said to be back of the project.

KALAMAZOO, MICH.—The Otsego Power Company, Limited, capital $200,000, has filed articles of association. The officers are Glenn L. Smith, Jackson, chairman; Edward B. Marrinane, Grass Lake, secretary, and Jacob H. Bootes, Jackson, treasurer.

NEW ALBANY, MISS.—A $50,000 electric light plant is to be established in this town.

JOPLIN, MO.—The city light plant of this place has shut down for want of fuel.

ST. LOUIS, MO.—The Missouri Edison Company is adding 1000-kw capacity to its plant.

ST. LOUIS, MO.—The Citizens' Electric Light and Power Company has increased its capital stock from $25,000 to $250,000.

MOUNTAIN GROVE, MO.—The citizens have voted to grant a twenty-year electric light franchise to the Ozark Cold Storage Company of this city.

ST. LOUIS, MO.—The Ewing-Meikle Electric Company has filed letters of incorporation with a capital stock of $50,000, paid up. The shareholders are Nathaniel Ewing, William Brown, Milton Mill and Wm. Meikle.

CHARLOTTE, N. C.—George Vanderbilt has purchased additional and extensive lands in Western North Carolina, including a fine water power where the power is secured for the old Patton Mills and the wool carders. There is some talk that the water power may be developed and carried to Brevard, N. C.

TOLEDO, OHIO.—The Maumee Valley Electric Company has re-elected its old officers.

WAPAKONETA, OHIO.—The lighting plant at St. Mary's has closed down for lack of fuel.

SIDNEY, OHIO.—Sidney was in darkness for several nights recently owing to inability to secure fuel for the municipal lighting plant.

SANDUSKY, OHIO—The Central Heating & Lighting Company, of Toledo, has asked for a franchise to install the Yaryan heating and electric lighting systems throughout the city.

PRAIRIE DEPOT, OHIO.—The owner of the village lighting plant has shut down because he claims he cannot afford to pay the price demanded for coal. The town has a lighting contract and the authorities threaten to take charge of the plant.

RAVENNA, OHIO.—The Ravenna Gas & Electric Company has elected Charles Merts, president; W. J. Hayes, vice-president; W. A. Root, secretary; W. H. Beebe, treasurer, and E. C. Lindsey, superintendent. These with W. S. Krake, A. D. Knapp, W. H. Linton and W. H. Riddle constitute the board of directors. The company will improve its lighting plant.

FREMONT, OHIO.—The property of the Fremont Gas, Electric Light & Power Company has been transferred to the Logan Natural Gas & Fuel Company, but the old name will be retained for local purposes. S. A. Wheeler, of Lancaster, is president of the company; P. W. Lupher, Pittsburg, vice-president; John Lamsden, Norwalk, secretary, and Wm. Adams, Fremont, superintendent.

PORTSMOUTH, OHIO.—The Merchants' Heating, Light & Power Company has been formed by W. E. Anderson, Felix Haas, Leon Eisman, Wm. Burt and other merchants of this city, who are dissatisfied with the high rates of the local lighting company. It is the intention to establish a lighting plant and furnish light, heat and power to stores and residences. The company has a capital stock of $22,000 and has secured a 25-year franchise from the town.

CHATTANOOGA, TENN.—The city of Chattanooga will build a $125,000 electric light plant if the proposed bill for improvements goes through the Legislature.

SPRINGFIELD, TENN.—The Springfield Electric Light and Power Company has combined with a local ice plant and laundry, and will install new electrical laundry and ice machinery. The new concern will be known as the Springfield Ice, Light, Laundry and Power Company.

THE ELECTRIC RAILWAY.

FLORENCE, COLO.—The Florence Electric Street Railway Company of Colorado has recorded a trust deed for $2,700,000. The Eastern Trust Company of this city is named as trustee. The purpose of the company is to build 125 miles of electric railway to connect cities and towns in the Arkansas Valley.

JACKSONVILLE, FLA.—The Jacksonville Traction Company has been chartered with $400,000 capital. The incorporators are G. W. Shook and P. A. Dignan, of Jacksonville, and others.

CHARLESTON, ILL.—The city council was prevented from passing the ordinance granting a franchise to the Central Illinois Traction Company by an injunction. The case will be heard before the judge of the County Court later.

CAIRO, ILL.—Efforts have been under way for some time to consolidate the two street car lines and electric light companies of this city. It is now stated that the Cairo Electric Railway Company and the Cairo Electric Light and Power Company have an option on the entire property of the Egypt Electric Company and that the transfer of the property is to be made in a few days. The consideration asked for the property is nearly $40,000. The purchasers will conduct the two systems under the management of the present officers.

SHELBYVILLE, IND.—The Indianapolis, Shelbyville & Southeastern Traction Company will extend its road to Batesville.

WABASH, IND.—The Fort Wayne & Southwestern Traction Company has made financial arrangements for the extension of the road to Marion.

LOUISVILLE, KY.—Articles of incorporation of the Louisville & Interurban Railway Company have been filed. The capital stock is fixed at $500,000. The stockholders are T. J. Minary, J. B. Speed, Attilla Cox, John Stites, Harry Bishop, Clarence Dallam and J. M. Gaulbert. The new company proposes to operate electric lines in Jefferson, Shelby, Oldham, Bullitt and Spencer counties, and several different lines are contemplated. The company is authorized to borrow $3,000,000. All of those named are prominently connected with the Louisville Railway Company, and with the exception of Clarence Hallam are the present officers and directors of that company.

AUGUSTA, ME.—Work will be begun in the Spring on an electric road from Camden to Liberty, 19 miles. The capital stock will not exceed $500,000, the charter has been applied for and there is no opposition. The men to furnish the funds are: H. M. Bean, E. T. Knowlton, Willston Grinnell, Reuel Robinson, Robert L. Bean, W. E. Schwartz, Lucius Morse, of Camden; Charles E. Littlefield, of Rockland; H. L. Shepherd, of Rockport; Charles W. Henry, Philadelphia, and John G. Crowley, of Taunton.

JACKSON, MICH.—The Jackson & Battle Creek Traction Company, has made arrangements for two classes of service on the road. One class will be a limited service, on which the cars will be speeded up to a mile a minute, and no stops will be made except at stations. The other service will be a "pick-up" service, by combination express and passenger cars. The limited service, it is said, will make the forty-five miles between Jackson and Battle Creek in an hour and twenty minutes.

ALBANY, N. Y.—The West 86th Street Railway Company of New York City has been incorporated to operate an electric street surface railroad, 2,000 feet long, on West 86th street, from Eighth avenue to Amsterdam avenue. The capital is $10,000 and the directors are Charles E. Warren and D. B. Hasbrouck, of Brooklyn; Oren Root, Jr., M. G. Starrett, R. W. Meade, R. Martin and Denis O'Brien, of New York City; De Clifford Moorehead, of Jamaica and F. D. Edmunds, of Flushing.

NORWALK, OHIO.—The Lake Shore Electric Railway Company is preparing to establish a sub-station at Vermillion.

TOLEDO, OHIO.—It is stated that the Lake Shore Electric Railway is securing a right of way for a spur line from Genoa to Elmore, Port Clinton and Lakeside.

CINCINNATI, OHIO.—B. H. Kroger, one of the chief promoters of the Cincinnati, Milford & Goshen Electric Railway, states that contracts for the construction and equipment of the road will be placed February 15.

EAST LIVERPOOL, OHIO.—The Youngstown & Southern Railway has accepted the franchise granted in East Liverpool. The section between Lisbon and East Liverpool is to be built first and contracts are to be closed in the near future.

CLEVELAND, OHIO.—The Everett-Moore syndicate admits the truth of the report that an eastern syndicate has made overtures looking to the lease of the property of the Toledo Railways & Light Company, of Toledo, and the Detroit United Railway, of Detroit.

BOWLING GREEN, OHIO.—The Port Clinton Peninsular Electric Railroad Company has been incorporated by Charles York, of Port Clinton; W. M. Tuller, Dr. F. W. Rogers, R. N. Beatty and Charles M. Draper, of Bowling Green. It is proposed to build a line from Port Clinton to Marblehead and Lakeside by way of Oak Harbor and Elmore.

GUTHRIE, OKLA.—The Mountain Park Electric Railway Company, of Mountain Park, has been incorporated with a capital of $50,000, by R. D. Simpson, C. J. Galena, Mark Roberts and J. C. Brown.

WHEELING, W. VA.—Directors of the Wheeling Traction Company have declared a 1 per cent. dividend, amounting to $20,000. It is the first dividend paid by the company.

NEW INDUSTRIAL COMPANIES.

THE McCREARY ELECTRIC COMPANY, of New York, has been incorporated, capital $25,000. Directors: A. A. McCreary, H. W. Brooks, Jr., and H. W. Brooks, New York.

THE SUNDH ELECTRIC COMPANY, New York, has been incorporated, capital $100,000. Directors: W. E. Quimby, New York; Austin Colgate, Orange, N. J.; W. J. Tuigue, Greenwich, Conn.

THE CHARLES L. EIDLITZ COMPANY, of New York, has been incorporated to install electric light, heat, and power plants, capital $50,000. Directors: C. L. Eidlitz, F. M. Dyer and Roger Lewis, New York.

THE CENTRAL ELECTRIC AND MANUFACTURING COMPANY, Youngstown, Ohio, Capital $20,000, has been incorporated by W. L. Goodhart, E. F. Foreman, L. C. Glass, E. G. Anderson and C. H. Denison.

THE INTER-URBAN CONSTRUCTION COMPANY, capital $10,000, has been incorporated at Toledo, Ohio, by H. F. Shunck, A. F. Klauser, J. H. Pheat and others. It will construct telephone systems, lighting plants, etc.

THE CABLE JOINT COMPANY OF AMERICA, of New York City, has been incorporated to manufacture cable joints and electric appliances. Capital, $12,500. The directors are J. D. Maguire, W. M. Murphy, of New York City, and G. F. Valentine, of Larchmont.

THE NATIONAL CONSOLIDATED COMPANY, of Middletown, N. Y., has been incorporated to manufacture gas and electricity for villages in Orange and Sullivan Counties, capital $50,000. Directors: Charles M. Priggen and G. R. Larwill, Brooklyn; Henry Floy, New York.

THE D. L. BATES & BROTHERS COMPANY has been incorporated at Dayton, Ohio, with $20,000 capital stock, by D. L. Bates, R. H. Bates, Harry Bates, E. J. Monstephen and Alex. Euchenhofer. The company will manufacture electric fans, motors and other electrical goods.

THE ACME CONDUIT COMPANY has been incorporated under the laws of the State of New Jersey, with a capital stock of $300,000. The incorporators are William C. Ball, Rutherford, N. J.; Thomas D. Holland, New York City; John Peck, Jr., Brooklyn, N. Y.; William L. Eaton, Brooklyn, N. Y., and John J. O'Leary, New York City. The company will engage in the manufacture of conduits, pipes, etc.

LEGAL.

WESTERN UNION RAILROAD LINES.—The Western Union Telegraph Company has taken an appeal in the case recently decided by Judge Buffington in favor of the Pennsylvania Railroad Company. The court refused to permit Western Union to file a bond to condemn certain portions of the right of way of the Pennsylvania Company and also declined to enjoin wires of Western Union, if they were not removed by June 2, 1903.

OBITUARY.

SIR G. C. STOKES.—Electrical engineers and physicists in this country regret to note that Sir George Gabriel Stokes, Master of Pembroke College, Cambridge, and formerly President of the Royal Society and of the British Association, is dead. He was created a baronet in 1889. He was born at Skreen, County Sligo, Ireland, in 1819. He was a younger son of the Rev. Gabriel Stokes, Rector of Skreen. He was educated at Bristol College, and then at Pembroke College, Cambridge, where he was senior wrangler in 1841. In the same year he was elected Fellow of Pembroke. Ten years later he was made a Fellow of the Royal Society, and from 1885 to 1890 he was its President. He received the Prussian Order of Merit and was Member of Parliament for Cambridge University from 1887 to 1892, when he became Master of Pembroke. He was an honorary D. C. L. of Oxford and an honorary LL.D. of Edinburgh, Dublin, Glasgow, Aberdeen, and Cambridge, as well as Sc. D. of the last. He had published several valuable books upon mathematics and physics—"The Philosophical Transactions of the Royal Society." "The Cambridge Philosophical Transactions," both in scientific serials.

PERSONAL.

PROF. J. J. THOMSON has, we learn with regret, declined the offer of the Chair of Physics at Columbia University.

MR MARCONI deferred his departure to Europe to attend a banquet given in his honor by the Montreal board of trade, and sailed on the Etruria last Saturday.

MR. H. F. SANVILLE, Girard Trust Building, Philadelphia, has recently added to the line of well-known manufacturers of street railway materials whom he represents, the local agency for the Johnson Wrecking Frog.

MR. W. H. BRYAN, M. E., consulting engineer, lectured on February 3 before the Washington University Association, of St. Louis, on "The Mechanical Engineer: His Duties, Responsibilities and Opportunities."

MR. H. H. LITTELL, who was lately elected president of the Central Illinois Consolidated Railway, has gone to Louisville, Ky., and is pushing work in his usual vigorous manner. Additional lines are to be built at once.

MR. ALEX DOW, general manager of the Detroit Edison system, was a visitor at this office last week. He has been visiting the East in regard to matters connected with the growth of that company and its new plant.

SIR HIRAM MAXIM is as versatile and mentally active as ever, and writes to the *New York Herald* from Nice a very interesting and amusing discussion of systems in gambling. The pith of his argument is that no system is sure, but any is better than none.

MR. KERN DODGE, of the firm of Dodge & Day, modernizing engineers, of Philadelphia, read a paper before the Franklin Institute on Jan. 22, on "Power Cranes in Machine Shops." This paper with illustrations is to be printed in full in the Journal of the Franklin Institute.

MR. MARCONI, who sailed for Europe on Saturday last by the Cunarder Etruria, has decided to make an effort with the liner's wireless outfit to send a message from midocean to the station at Nantucket. It is probable that he may, when midway between the Nantucket and Cornwall stations, act as the "central" or relay for messages between them.

MR. EDWARD H. SNIFFIN.—At the last American Street Railway Convention in Detroit, Mr. E. H. Sniffin presented a most interesting paper on the commercial aspects of the steam turbine. This has now been reprinted and issued in pamphlet form, and is a worthy addition to any engineer's library. It is a special publication by Westinghouse, Church, Kerr & Co., of New York.

MR. S. TADA, a lieutenant in the Japanese Navy, is now in this country supervising some Westinghouse electrical work for a new steel plant in Japan. He has been visiting New York and these offices during the past week, and was accompanied by Messrs. C. Aoyama and I. Hata, who are also here for the purpose of investigating and purchasing telephone apparatus and supplies for the Japanese Government telephone system.

PROF. DUGALD C. JACKSON and his brother, W. B. Jackson, M. E., have established themselves as a firm of consulting electrical and mechanical engineers. etc., with headquarters at Madison, Wis. They are both highly known and widely esteemed, and should enjoy a large practice. Mr. Jackson will be in active charge of the office, etc., and Prof. Jackson will continue his valuable services at the University of Wisconsin.

MR. GEORGE H. GIBSON has resigned his position with the Westinghouse Companies' Publishing Department, of Pittsburg, Pa., to accept a position with the B. F. Sturtevant Company, of Jamaica Plain Station, Boston, Mass., the well-known manufacturers of blowers, heating, ventilating and forced-draft apparatus, electrical machinery and steam engines. Mr. Gibson was formerly a member of the editorial staff of *Engineering News*, and is a graduate of the Engineering School of the University of Michigan.

MR. A. N. BRADY, who returned last week after an absence of several weeks in Paris, whither he had gone to negotiate for an interest in the gas company of that city, gave out the following statement regarding the results of his efforts: "Upon an invitation from some financial interests of Paris, we have visited their city with the view to invest capital in the gas plant. After looking over the situation, we have made them a proposition to join them in the enterprise, which proposition is being considered at the present time. There has been no definite conclusion reached as yet, but it is expected that the matter will be decided within a short time."

NEW YORK ELECTRICAL SOCIETY.—At the meeting of the Society on January 29, the following members were elected: Harold D. Patterson, Richard H. Johnston, Anderw Moss, Almon B. Fuller, Wm. Edw. Hurley, Wm. Taylor, Robert Chas. Cole, Joseph Burkhart, F. L. Scheffey, Ralph Ryder, Chas. F. Case, Seth C. Adams, W. J. Floyd, A. E. Baker, F. E. Osborne, Prof. Magnus C. Ihlsing, Charles G. Whyte, Louis Dornbusch, Edwin Hopkins Seaman, Wallace Cudliff, Joel B. Ives, F. Schwanbausser, Norman A. Paul, Harry French, Edward Hartmann, Frank Cleary, John Benj. Brown, John Ryan, Edward B. Stott, William Weidman, L. R. Wetherwax, Ernest W. Muller, Carl Steuve, Anson S. Rice, Walter M. McBride, John Bittner, E. W. Stevenson, William J. Ladley, Edgar B. Benjamin, Francisco Laurent Godinez, W. F. Hurlbut, and J. F. Bidstrup.

MR. E. W. WINTER becomes president of the Brooklyn Rapid Transit Company, vice Mr. Greatsinger, who has retired. The Brooklyn system is using up able men in rapid succession. Reports of Mr. Greatsinger's coming resignation have been current for several months. Mr. Greatsinger, it is reported, will probably return to his former position of President of the Duluth and Iron Mountain Railroad, which he left in March, 1901, in order to become president of the Brooklyn Rapid Transit system. E. W. Winter has been acting as adviser to the Executive Committee of the company for several months. It is not expected that he will make any change in the operating staff, as the men now in charge were brought on from St. Paul on his advice. Mr. Winter was formerly a resident of that city, where he was interested in the Twin City Rapid Transit Company, the Northern Pacific Railway Company, and other railway enterprises.

MANVILLE-ROMAINE.—Miss Henrietta Estelle Romaine, daughter of Frank Hall Romaine, was married on Jan. 28, in the Church of the Heavenly Rest, New York, to Hiram Edward Manville, of Milwaukee, Wis., by the Rev. Dr. D. Parker Morgan. Mrs. Clarence Levey was the matron of honor; there were no bridesmaids. Mr. F. W. Rockwell was the best man, and Mr. Frank Hall Romaine, Jr., a brother of the bride, D. C. Pye, R. C. Caldwell and W. Mayne were ushers. A reception and wedding breakfast at Sherry's followed the ceremony. Among the invited guests were: Mr. and Mrs. J. G. Cannon, Mr. and Mrs. W. H. Porter, Mr. and Mrs. C. V. Manville, of Milwaukee, parents of the bridegroom; Mr. and Mrs. H. R. Trainer, Mr. and Mrs. C. R. Manville, Mr. and Mrs. Henry B. Hatch, Mr. and Mrs. W. T. Dickson, Mr. and Mrs. Samuel W. Wollverton, Dr. and Mrs. Geo. Manville, Mr. and Mrs. T. T. Lyman, Mr. and Mrs. W. C. Durland, Mr. and Mrs. T. F. Manville, Mr. and Mrs. Joseph Sachs, Mr. and Mrs. J. W. Perry, Mr. and Mrs. J. E. Meek, Mr. and Mrs. J. W. Gordy, Mr. and Mrs. J. G. Millar, Mr. and Mrs. W. Angevine, Mr. and Mrs. G. W. Wright, of Milwaukee; Mrs. Henry Gawtry, Mr. and Mrs. R. Stone, Mr. and Mrs. J. B. Brown, Mr. and Mrs. H. U. Kibbe, Mr. and Mrs. L. H. Fish and Mr. and Mrs. A. Parker Smith.

Trade Notes.

THE AMERICAN ENDOSCOPIC COMPANY, Providence, R. I., is sending out a card showing the latest type of incandescent night lamp outfit.

THE INTERNATIONAL PAPER COMPANY has just placed its sixteenth order with the Burt Manufacturing Company, Akron, O., for an oil filter, to be made out of copper.

THE MAIN BELTING COMPANY, Philadelphia, has issued a very attractive pocket memorandum book. The covers are celluloid and contain respectively an illustration of "Leviathan" belting in operation and a calendar for 1903. The book contains besides, blank memoranda pages, some very useful information concerning the installation and proper care of belts.

BATTERY FAN MOTOR.—Messrs J. Jones & Son, 64 Cortlandt St., New York, announce that their 1903 type of battery fan motor is ready for delivery. In appearance this fan differs very little from the standard type of fan motors which are operated from supply circuits. The fan is 10 inches in diameter and has 4 blades, a regulation fan-guard with each machine.

THE CLEVELAND CONSTRUCTION COMPANY, Cleveland, Ohio, engineers for the Washington, Baltimore & Annapolis Railway, has placed contracts with the Ohio Brass Company for insulating material; Mayer & Englund Company, Philadelphia, for cross arms, pins, hardware and bonds; American Steel & Wire Company for trolley wire and the Roebling Sons' Company for stranded wire. Other contracts are being closed.

A LONG TIME CALENDAR.—Messrs. Raber and Watson, Old Colony Building, Chicago, Ill., have issued a neat attractive desk calendar which by an ingenious device is made to cover a period from January, 1903, to December, 1910. The firm has very modestly refrained from covering the calendar with a mass of advertisement, incorporating on its face merely its name and address, with a memorandum of its specialty in three words—Cedar Telephone Poles.

THE HOLTZER-CABOT ELECTRIC COMPANY, Brookline, Mass., has issued an attractive 1903 calendar. Instead of containing the usual more-or-less decorative picture, a fine illustration in colors of the Holtzer-Cabot 1903 factory appears at the top. The work is well executed and a bit of harmonious coloring is the result. The calendar pad itself is a combination of brown and yellow and the entire production seems to have been planned for continuous utility rather than impressive gaudiness.

BELTS.—It is boldly asserted that the users of power machinery run no risk whatever in trying Graton & Knight's "Royal Worcester" and "Heart" brands belts. The position of the makers is logical. To make assurance doubly sure, they offer these belts solely on their ability to transmit power economically, and in order to push their claims to the limit, agree to send a belt to any reliable manufacturer to test in his own way, and if it is not found to be the most economical belt to use, it may be returned free of cost and full credit is given.

THE STANDARD POLE & TIE COMPANY, of No. 135 Front Street, New York City, is doing a large pole and tie business and covering a wide field in the Middle West. This company has enlarged its yards in the South and with added facilities and a rapidly increasing staff in all its offices, aims solely to please its customers. The standard of inspection is such that any orders sent to the New York office of the company will be satisfactorily filled. The company has removed to new offices in the Venezuela Building, 133-137 Front Street, New York.

500-VOLT FAN.—The Robbins & Myers Company, Springfield, Ohio, has brought out a 500-volt ceiling fan, upon the design of which the greatest care has been bestowed. To withstand this voltage extra heavy insulation has been provided on the windings, with such satisfactory results that the company is able to guarantee a degree of durability and efficiency which hitherto have been regarded well nigh impossible. This fan running at normal speed (200 r.p.m.) consumes 2 amperes. The company will be glad to send a copy of its circular, No. 25, describing this fan.

THE ELECTRIC STORAGE BATTERY COMPANY. of Philadelphia, has recently adopted a policy concerning the renewals of plates in exide batteries which will attract the favorable attention of users of electric vehicles in that it reduces to a minimum the cost of these new parts. Information regarding this may be secured from any of the sales offices of the company or from the Exide battery depots at Philadelphia, New York, Chicago, St. Louis, Buffalo, Rochester and Detroit. At the recent Automobile Show at Madison Square Garden, New York, it was noted that of the eight manufacturers of electric vehicles exhibiting, six used the Exide batteries.

THE GREGORY ELECTRIC COMPANY, of Chicago, reports business as exceptionally brisk. This company is constantly increasing its foreign trade and is now known in every foreign land as well as in its own country as headquarters for bargains in second hand electrical apparatus. Owing to its advantages, geographical location and fine shipping facilities this company is quoting delivered prices to customers if desired and is securng orders against the strongest competition in regions where freight rates might ordinarily be considered prohibitive. The repair shops of this company are also very busy at present—upward of 90 men being now employed in this department alone.

ELECTROTHERM.—We have received from the H. W. Johns-Manville Company, New York, advance sheets of an interesting leaflet now being brought out by the company on the subject of its Electrotherm. As is already well known the Electrotherm is a flexible sheet or pad into which are woven wires insulated and protected by asbestos. When the pad is connected to an incandescent circuit, the current produces in it a constant and uniform degree of heat. These pads are designed for the local application of heat in bodily ailments, and are far superior to the hot-water bottle for this purpose. The advantages and uses of the Electrotherm and other particulars are given in the leaflet.

STOREY MOTOR & ELECTRIC COMPANY, of Newark, N. J., is in receipt of the following significant letter from Mr. S. W. Putnam, vice-president of the Putnam Machine Company, of Fitchburg, Mass.: "We have just completed the 14" lathe upon which the ¾-hp motor, recently purchased of you, was installed, and desire to state that we are very much pleased with the apparatus as furnished. Mr. P. M. Brotherhood has some interesting samples of work done on this lathe, and we suggest that when convenient you call at the New York office of Manning, Maxwell & Moore to see same, as we think they will be of interest to you, especially the sample of screw cutting, which we do not hesitate to say cannot be done on any belt-driven lathe without stopping lathe and pulling belt by hand."

THE ELECTRICAL POWER STORAGE COMPANY, LTD., 4 Great Winchester St., E. C., London, England, emphasizes to what extent the distribution of advertising matter may go. Its contribution to 1903 souvenirs is a complete office desk pad. Across the top, temporarily fastened by brass clips is a day calendar for the month. This calendar is removable so that the proper month is always before the user. At the left of the pad is a diary for the entire year, containing the usual spaces for daily entries, cash account, alphabetical indexing, etc., while the remainedr is desk pad proper. This pad carries with it life insurance against accident in the United Kingdom to the amount of £500. The desk blotter is of immense practicability and the company is to be congratulated on distributing such a useful advertisement.

THE STUART-HOWLAND COMPANY, Winthrop Square, and 261 Devonshire Street, Boston, has for several weeks been making alterations, erecting offices, shelving, etc., in its enlarged quarters, and its store and offices are now a model of neatness and convenience, the equal of which would be hard to find. Everything is arranged for the quickest possible handling of goods and at a minimum of cost. There are three elevators, which are kept active, and in addition, two immense slides for receiving heavy goods in the basement. The store has a frontage of about 60 feet on Winthrop Square and about 200 feet on Devonshire Street. Judging from the activity of the shippers, and the quantities of goods on the sidewalks awaiting draymen, the business of this enterprising firm promises soon to outgrow its enlarged facilities. The company is New England agent for the entire line of "Peerless" fans, and also handles General Electric alternating desk and Tuerk alternating ceiling fans.

AUTOMATIC TELEPHONES IN IOWA.—The Central Telephone Construction Co. is buying up various independent telephone exchanges in the State of Iowa and equipping them with automatic exchanges made by the Automatic Electric Co., of Chicago, under the Strowger patents. The Central Telephone Construction Company is closely allied to the Illinois Telegraph & Telephone Company, which is building the automatic telephone exchange in Chicago. Rufus C. Dawes is the president of the central company. Charles H. Geist, vice-president and general manager, and A. G. Wheeler, Jr., secretary and treasurer. Independent exchanges have been purchased in Iowa at Waterloo, Cedar Falls, Normal, Waverly, El Dora, Traer, Parkersburg, Reibeck, Shell Rock, Ackley, Dysart, Clarkville, Allison, La Porte City, Briston, Dumont, Hudson, Tripoli and Grundy Center.

THE GARDNER ELECTRIC DRILL & MACHINERY COMPANY is now putting out a number of sizes of its electric rock drill, which has been in use in the far Western mines for several years. Now that electricity is coming to be used to such an extent in mining, the elimination of compressed air, which has commonly been used for rock drills, is sometimes desirable. These drills are not on the solenoid principle, but make use of motion transmitted from an electric motor through a flexible shaft to the drill mechanism. The motor is placed in some convenient position near the drill. The stroke is not quite as long nor the plow quite as heavy as in the air drill, but the strokes are more rapid, being from 550 to 600 per minute. Where current for operating the drill is at hand in a mine, the initial cost is much less for the electrical than for the compressed air equipment, where only a few drills are to be used.

JANDUS FANS.—How to keep cool is a question that enters the minds of a good many millions of people during hot weather, and, although this problem is not yet forcing itself upon the attention of the public it soon will be doing so. In anticipation of the great demand for fan motors the coming season the manufacturers of these comfort-giving machines are busily engaged on their 1903 product. The Jandus Electric Company, Cleveland, Ohio, will bring out one or two designs this year, which will embody several improvements. The company is at work on a complete line of alternating and direct-current fans, of 12-in., 15-in., and 16-in. sizes. They will be better than last year's designs, notwithstanding the high degree of perfection attained in the latter product. One of the novelties this year will be a ceiling fan, consisting of two revolving fans, adjustably mounted so as to throw the air at any desired angle. Any size fan, alternating or direct current, can be interchangeably mounted on the fixture. A feature of the Jandus fan is that it is a desk, bracket and trunnion fan all-in-one.

PASS & SEYMOUR CATALOGUE.—The Catalogue No. 14 of Pass & Seymour, Inc., Solvay, N. Y., is a fine specimen of what can be done with good cuts, good paper and intelligent press work. It contains 78 pages and contains about as handsome illustrations as it is possible to find in any similar publication. A full line of things in porcelain is shown, covering about 60 pages. As is mentioned in the introduction to the catalogue, there is purposely omitted a long description of each of the pieces. In fact, of the 60 pages which are given over to illustrations of various Pass & Seymour specialties, there are contained on only nine pages any descriptive matter concerning the pieces shown. It is left to the reader to understand to what uses the various specialties are to be put; and the reputation of the company has made it unnecessary, the author feels, to enter into any extended argument to the effect that the Pass & Seymour products are good of themselves. Hence, the catalogue is a concise, comprehensive list of what Pass & Seymour make, showing the various sizes of the pieces and indicating the various adaptations of each. In addition to the illustration and description of the sizes and adaptations already referred to, there is contained in the catalogue a trade number of each particular piece, together with a code word. On one or two pages in the catalogue is given an explanation of the manner in which the code operates. At the back of the catalogue is a table entitled "Useful Information," which has to do with the description of some of the electrical units. Then follows a very comprehensive code. The general plan of the code is that any word beginning with a certain letter stands for a complete sentence and may, therefore, be easily located and its meaning ascertained, while some other word beginning with an entirely different letter refers to the name of a company. Then there are combinations

of three letters each in a numerical code which enables a combination from 1 up to 10,000 and covers dollars and cents as well as numerals. Following this table in the catalogue is what is known as a numerical code, whereby if anyone knows the trade number of any of the Pass & Seymour pieces, it may easily be found by reference to this index, where the numbers are arranged in numerical order with the code word set against it, followed in turn by the page number of the catalogue in which this piece is shown. Following that again is the alphabetical code index in which all of the code words are arranged in alphabetical order and the page on which the various pieces are shown as indicated, after which comes the general index showing all of the pieces arranged in alphabetical order according to their names. It is a very complete publication that Pass & Seymour have issued.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JANUARY 27, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

718,660. THERMAL ELECTRIC CUT-OUT; T. E. Scantlin, Lafayette, Ind. App. filed September 5, 1901. (See page 243.)

718,797. SAFETY-FUSE. J. Sachs, Hartford, Conn. App. filed September 30, 1901. (See page 243.)

719,003. SURFACE CONTACT STRUCTURE; E. M. Hewlett, Schenectady, N. Y. App. filed Oct. 20, 1897. A contact button is threaded to the end of a bolt placed in an axial cavity in a wooden block, the cavity being filled with insulating material surrounding the bolt.

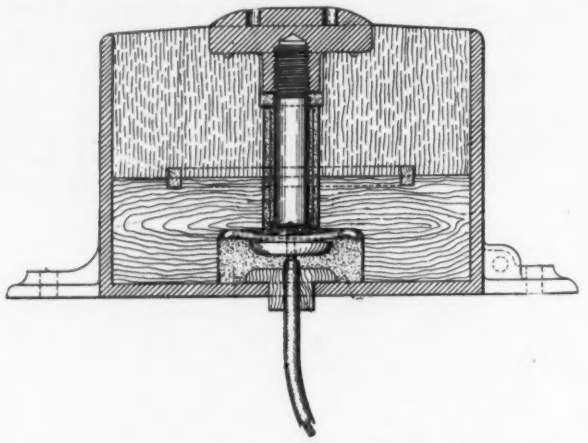
719,005. TUNING DEVICE FOR WIRELESS TELEGRAPHY; W. S. Hogg, United States Navy. App. filed March 4, 1902. (See Current News and Notes.)

719,006. TROLLEY; A. J. Johnson, Cleveland, Ohio. App. filed April 14, 1902. The force of the spring acting upon the pole is automatically altered to correspond with the angular position of the pole.

719,016. ELECTRIC RAILWAY; M. T. A. Kubierschky, Berlin, Germany. App. filed March 22, 1900. The electromagnetic switches in the branch circuits to the working conductor control two circuits, one leading through the car motor and the other through the coil of an advance switch, to the return.

719,018. AUTOMATIC ELECTRIC CIRCUIT CONTROLLER; H. W. Leonard, New York, N. Y. App. filed May 7, 1901. A hammer-arm normally restrained, is released when the electromotive force passes a certain limit.

719,020. RAILWAY ELECTRIC MOTOR COOLING SYSTEM; C. O. Mailloux, and W. C. Gotshall, New York, N. Y. App. filed Oct. 6, 1902. A controller acts periodically upon a valve which admits compressed air from any suitable source into a piping system which conveys the air to the motors for cooling purposes.



719,003.—Surface Contact Structure.

719,024. ALTERNATE CURRENT TRACTION SYSTEM; W. M. Mordey, London, Eng. App. filed Nov. 14, 1902. (See Current News and Notes.)

719,025. ELECTRIC FUSE OR CUT OUT; H. L. Morse, Boston, Mass. App. filed Feb. 24, 1902. An indicator consisting of a piece of fabric stretched across an opening in a fuse case, is thrust outward by the pressure created by the disruption of the fuse.

719,026. ELECTRIC FUSE OR CUTOUT; H. L. Morse, Boston, Mass. App. filed July 25, 1902. A modification of the preceding patent.

719,055. SWITCH CONTROLLING APPARATUS; C. W. Squires and J. B. Squires, Springfield, Mass. App. filed July 2, 1902. Various improvements in electro-magnetic apparatus for throwing a railway switch. The magnet is operated on a circuit independent of the motor and the arrangement is such that the switch tongue is held immovable during the passage of a car.

719,092. ELECTRIC SELF PLAYING PIANO; G. H. Davis, New York, N. Y. App. filed March 22, 1899. The invention relates more particularly to the connections between the electric motor and the drum controlling the movements of the music sheet and has special reference to the rewinding mechanism.

719,093. ELECTRICAL SELF PLAYING MUSICAL INSTRUMENT; G. H. Davis, Brooklyn, N. Y. App. filed Nov. 26, 1900. A modification of the preceding patent.

719,095. LINE-TAPPING DEVICE FOR TELEGRAPH OR TELEPHONE CIRCUITS; C. Dietz, Munich, Germany. App. filed August 2, 1902. (See page 243.)

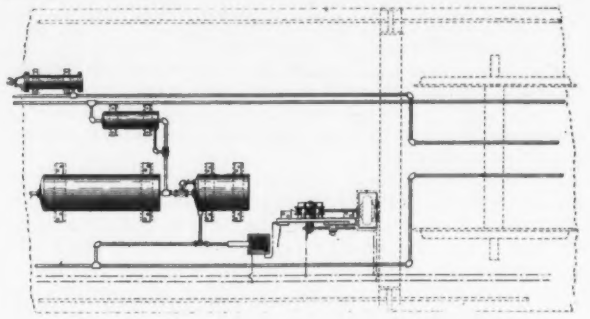
719,112. TROLLEY WIRE SUPPORT; E. Hill, South Norwalk, Conn. App. filed May 7, 1902. The trolley wire clip is extended in length and grasped by a number of hangers.

719,114. ELEVATOR; N. Hiss, New York, N. Y. App. filed May 22, 1902. An electro-dynamic brake for the hoisting apparatus and means for successively controlling the movement of the motor and applying the brake.

719,122. AUTOMATIC ELECTRIC SWITCH; W. Lasar, St. Louis, Mo. App. filed Feb. 11, 1902. An elevator switch is operated from any floor by means of a rope accessible on the various floors; indicators on the floors show the result of the operation.

719,149. ELECTRIC ARC LAMP; A. F. Shore, New York, N. Y. App. filed Jan. 29, 1900. Ring-shaped carbons are controlled through suitable worm-gearing by a solenoid.

719,167. MAGNETO ELECTRIC MACHINE; J. M. Wilson, Battle Creek, Mich. App. filed April 14, 1902. A spring acting upon the armature shaft is put under tension and suddenly released to create an impulse of high potential.



719,020.—Railway Electric Motor Cooling System.

719,180. ELECTRIC CAR SIGN; I. B. Brower, Philadelphia, Pa. App. filed April 4, 1902. A sign box containing lights is mounted upon a peculiarly constructed pivot through which the circuit leads.

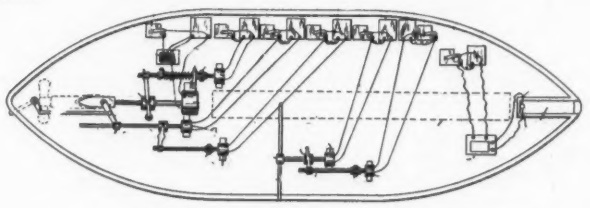
719,219. TELEPHONE SYSTEM; W. Hohne, Schöneberg, Germany. App. filed April 17, 1902. (See page 243.)

719,265. ELECTRIC SOCKET; A. P. Seymour, Syracuse, N. Y. App. filed Feb. 10, 1902. Details.

719,315. STORAGE BATTERY; C. H. Everett, Atlanta, Ga. App. filed July 8, 1901. Arms extend laterally from a vertical support and sustain sheet metal strips which are threaded over them, to form the metallic portion of an electrode.

719,355. ELECTRIC TELEGRAPHY; A. Muirhead, Shortlands, England. App. filed Aug. 11, 1902. The combination in a telegraphic relay, of a receiving coil energized by message impulses, an index actuated by the coil, means applied directly to the index, independently of the coil, to give directive force thereto and further means serving to turn a part of said first-named means to give directive force to the index and thereby correct the "zero" thereof.

719,388. ELECTRIC DANGER AND SAFETY SIGNAL FOR RAILWAYS; H. F. Spurr, Jr., Boston, Mass. App. filed April 24, 1902. Details of a block system in which the signals are displayed in the cab of the locomotive.



719,405.—Appliance for Electrically Operating Vessels and Torpedoes from a Distance.

719,397. DRY ORE SEPARATOR; R. E. Waugh and E. Waugh, Denver, Colo. App. filed Sept. 21, 1901. The crushed ore is delivered upon a porous belt and is separated by the combined action of gravity, electro-magnetism and compressed air, the air being forced through the pores of the belt.

719,405. APPLIANCE FOR ELECTRICALLY OPERATING VESSELS AND TORPEDOES FROM A DISTANCE; L. Wilson, Brooklyn, N. Y. App. filed April 21, 1902. The torpedo is fitted with a number of motors for performing the various functions of propelling, steering, etc., and each motor is controlled by an independent wireless receiving apparatus of which the corresponding transmitting apparatus is located on shore.